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NUCLEAR SCIENCE ABSTRACTS

Volume 11 March 15, 1957 No. 5

GENERAL

ATOMIC BOMBS AND WARFARE

2773 AECU-3350

Lovelace Foundation for Medical Education and Research, Albuquerque, New Mexico.

BIOLOGICAL EFFECTS OF BLAST FROM BOMBS. GLASS FRAGMENTS AS PENETRATING MISSILES AND SOME OF THE BIOLOGICAL IMPLICATIONS OF GLASS FRAGMENTED BY ATOMIC EXPLOSIONS. Progress Report. I. Gerald Bowen, Donald R. Richmond, Mead B. Wetherbe, and Clayton S. White. June 18, 1956. 48p. Contract AT(29-1)-1242.

An exploratory study was made whose aim was to evaluate the damage done by low velocity (less than 1000 ft/sec) missiles consisting of small fragments of ordinary window glass striking in random orientations a biological target. The index of damage was chosen to be the penetration of the abdominal wall of anesthetized dogs. By use of appropriate laboratory data, a criterion of penetration was derived which expresses in equation form the probability of penetration in terms of missile mass and impact velocity. The penetration criterion was applied individually to data for 2486 glass missiles originating in test houses placed on Operation Teapot at various ranges from ground zero. By use of other statistical procedures, expectation of penetration was computed as a function of overpressure for the region between 1.9 and 5.0 psi. It was found that maximum expectation occurred at about 3.8 psi. The general biological significance of the results obtained was discussed. (auth)

2774 WT-1168

Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.

DISTRIBUTION AND DENSITY OF MISSILES FROM NUCLEAR EXPLOSIONS. I. Gerald Bowen, Allen F. Strehler, and Mead B. Wetherbe. Mar. 1956. 113p. Project 33.4 [of] OPERATION TEAPOT. $0.60(OTS).

The ballistic properties of low-velocity missiles which are produced inside various types of houses following a nuclear explosion were examined systematically. Properties considered include composition, such as glass, stone, wood, shape, mass, velocities, trajectories, and density in space, that is, the number of missiles which pass through a unit area in a given vertical plane in space. Data were obtained for each of several typical locations relative to Ground Zero, and also relative to surrounding structures in which human beings might find themselves in the event of an actual explosion. The means by which the data were obtained are discussed in detail. Photographs illustrating damage from missiles are included. (C.H.)

ATOMIC POWER

2775

MANAGEMENT, ECONOMICS AND TECHNOLOGY FOR THE ATOMIC INDUSTRY. Vol. I: MANAGEMENT AND INTERNATIONAL AFFAIRS. Vol. II: ECONOMICS AND TECHNOLOGY. William J. Smith, ed. New York, The Atomic Industrial Forum, Inc., 1956. Vol. I 282p., Vol. II 308p. $5.00 per Vol.

Problems relating to atomic energy in law, manpower needs and information needs in private industry are discussed. Atomic energy programs in Japan, Netherlands, Switzerland, France, Sweden, and Germany are summarized. New power reactor concepts in liquid metal, organic moderated, gas turbine and sodium deuterium are reviewed. New reactor projects are explained and their costs are evaluated. Progress in reactor materials, reactor safety, research programs, and radiation utilization is reported. (F.S.)

BIOLOGY AND MEDICINE

2776 USNRDL-TR-116

Naval Radiological Defense Lab., San Francisco.

THE ROLE OF SEROTONIN IN BLOOD COAGULATION. W. L. Milne and S. H. Cohn. Nov. 8, 1956. 14p. Project NM 006-015.

Serotonin (5HTA) was found to play an active role in blood coagulation in addition to its previously demonstrated role as a vasoconstrictor. In whole blood from normal and irradiated animals, and in platelet deficient plasma, 5HTA acts in a manner similar to platelet factor 2 in accelerating the conversion of fibrinogen to fibrin. In a purified fibrinogen solution, 5HTA inhibits the fibrinogen-fibrin reaction, and thus differs from platelet factor 2. This may be due to the absence of an anti-thrombin in the purified fibrinogen solution. Serotonin appears to have a therapeutic effect on the post-irradiation coagulation defect in that it decreases the prolonged heparin clotting time. This increased sensitivity to heparin during the post-irradiation thrombocytopenia may be due to a deficiency of serotonin, which acts as an antagonist to heparin (an anti-thrombin). Serotonin is postulated as an antagonist of an anti-thrombin which blocks the fibrinogen-to-fibrin reaction. (auth)

RADIATION EFFECTS

2777 AECU-3378

Utah. Univ., Salt Lake City.

THE MECHANISM OF THE PHOTOCHEMICAL ACTIVITY OF ISOLATED CHLOROPLASTS. 3. LIGHT INTENSITY DEPENDENCE. 4. EFFECT OF pH. 5. EFFECT OF HEAVY WATER. Technical Report No. 21. John S. Rieske, John D. Spikes, and Rufus Lumry. July 15, 1956. 114p. Project No. 4. Contract AT(11-1)-82. $18.30 (ph OTS); $6.00(mf OTS).

Results are reported from a preliminary kinetic study of the Hill reaction in photosynthesis. Potentiometric measurements were made of oxidant reduction. Emphasis was placed upon the development of techniques necessary for quantitative kinetic measurements with this reaction. Data are included on the influence of light intensity, pH, and the effects of heavy water on photochemical activity in isolated chloroplasts. (71 references.) (C.H.)

2778 AF-SAM-56-8
Utah. Univ., Salt Lake City. Coll. of Medicine.
THE INFLUENCE OF TOTAL BODY X-IRRADIATION AND IMMUNIZATION ON INTRACELLULAR DIGESTION BY PERITONEAL PHAGOCYTES. David M. Donaldson, Stanley Marcus, Ko Ko Gyi, and Eugene H. Perkins. July 22, 1955. 12p.

2779 NP-6176
Chicago. Univ. Air Force Radiation Lab.
QUARTERLY PROGRESS REPORT NO. 21. Oct. 15, 1956. 125p. Contract AF41(657)-26.

Progress is reported in studies on the survival time, weight loss, and mortality of mice treated with various chemical compounds before and following the administration of various doses of whole-body x irradiation; changes in the 5-nucleotidase activity of the spleens, livers, and thymus glands of rats and guinea pigs given single and repeated doses of whole-body x irradiation; a comparison of the injurious effects of various fractionated doses of x radiation as measured by adenosine triphosphatase assay on the tissues of rats; the effects of injections of recovering spleen cells derived from donor mice treated with 6-mercaptopurine, aminopterin, myleran, and triethylene melamine on survival and the adenosine triphosphatase activity of the spleens and thymus glands of irradiated mice; and the influence of exposure to low levels of γ and fast neutron irradiation on the life span of mice. A description is presented of a γ and fast neutron irradiation facility which was constructed for use in studies on the effects of fractionated low-level exposures on the life span of mice. Methods for making dosimetry measurements and handling the irradiation source, and the animal irradiation cages are also described. (For preceding period see NP-6067.) (C.H.)

2780 USNRDL-TR-114
Naval Radiological Defense Lab., San Francisco.
RADIATION-INDUCED CHANGES IN TISSUE NUCLEIC ACIDS: RELEASE OF SOLUBLE DEOXYPOLYNUCLEOTIDES IN THE SPLEEN. L. J. Cole and M. E. Ellis. Oct. 12, 1956. 31p. Project NM 006-015.04.

Biochemical changes in nucleic acids of the spleen in mice were investigated at hourly intervals up to 14 hr following lethal whole-body x irradiation (810 to 850 r). As early as 1 hr post-irradiation, there was a significant increase in the level of deoxypolynucleotide. The value rose to a maximum of 350 μg polynucleotide per spleen at 4 to 6 hr, and thereafter declines steadily, so that essentially zero levels were obtained at 14 hr and remained so for 4 days. The maximum levels of polynucleotide occurred at a time when the deoxyribonucleoprotein content was falling precipitously. Spleens of nonirradiated mice contain 20 μg polynucleotide per spleen or approximately 1 per cent of the total deoxyribonucleic acid in this tissue. The data suggest that spleen deoxyribonucleoprotein is the source of the free polynucleotide released after irradiation. (auth)

2781
THE SIZE AND SHAPE OF THE RADIOSENSITIVE ACETYLCHOLINESTERASE UNIT. Irving Serlin and Donald J. Fluke (Brookhaven National Lab., Upton, N. Y.). J. Biol. Chem. 223, 727-36(1956) Dec.

2782
INFECTION AND IMMUNITY IN RADIATION SICKNESS. N. N. Klemparskaya. Med. Radiol. 1, No. 5, 3-10(1956) Sept.-Oct. (In Russian)

2783
CHANGES IN NERVOUS REFLEXES IN TOTAL BODY X RADIATION. N. K. Poplavskii (Central Research Inst. of Roentgen-Radiology). Med. Radiol. 1, No. 5, 10-13(1956). Sept.-Oct. (In Russian)

2784
THE CHANGES IN THE CORNEAL EPITHELIUM DUE TO THE MULTIPLE EXPOSURE TO SMALL DOSES OF X RADIATION. I. B. Bychkovskaya (Central Research Inst. of Roentgen-Radiology). Med. Radiol. 1, No. 5, 16-22(1956) Sept.-Oct. (In Russian)

2785
EFFECTS OF IONIZING RADIATION ON THE OPTIC NERVE OF RABBITS. A. B. Tsypin. Med. Radiol. 1, No. 5, 22-30(1956) Sept.-Oct. (In Russian)

2786
CARCINOGENIC EFFECTS OF IONIZING RADIATION. M. N. Pobedinskii. Med. Radiol. 1, No. 5, 30-40(1956) Sept.-Oct. (In Russian)

2787
EFFECT ON SUCKLING YOUNG OF X-IRRADIATION OF LACTATING MOTHER. Roberts Rugh (Radiological Research Lab., Columbia Univ.). Proc. Soc. Exp. Biol. Med. 93, 523-4(1956) Dec.

2788
SERUM TRANSAMINASE ACTIVITY IN X-IRRADIATED RABBITS. Lawrence J. Milch and Harry G. Albaum (School of Aviation Medicine, Randolph AFB, Texas and Brooklyn College, New York). Proc. Soc. Exp. Biol. Med. 93, 595-6(1956) Dec.

2789
STUDIES OF THE EFFECT OF RAPIDLY DELIVERED, MASSIVE DOSES OF GAMMA-RAYS ON MAMMALS. Wright Langham, K. T. Woodward, S. M. Rothermel, P. S. Harris, C. C. Lushbaugh and John B. Storer (Los Alamos Scientific Lab., New Mexico). Radiation Research 5, 404-32(1956) Oct.

2790
AN INTERPRETATION OF ORGAN WEIGHT CHANGE INDUCED BY TOTAL-BODY IRRADIATION. S. D. Warshaw (The Univ. of Chicago, Ill.). Radiation Research 5, 634-49 (1956) Dec.

2791
NUCLEIC ACID CHANGES IN RAT SPLEEN AFTER LOCALIZED X-IRRADIATION. M. Bererbom (Univ. of Kansas Medical Center, Kansas City). Radiation Research 5, 650-6(1956) Dec.

2792
RADIATION-INDUCED DELAY OF PUPATION IN DROSOPHILA. Rose C. Bourgin, Rolfs Krumins, and Henry Quastler (Univ. of Illinois and Carle Foundation, Urbana). Radiation Research 5, 657-73(1956) Dec.

2793
RELATIVE BIOLOGICAL EFFICIENCY OF 1000-KVP AND 250-KVCP X-RAYS. I. GENERAL INTRODUCTION. DETERMINATIONS BASED ON THE DOSE-SURVIVAL CURVES OF SACCHAROMYCES CEREVISIAE, HAPLOID AND DIPLOID. Henry I. Kohn and Shirley E. Gunter (Univ. of California School of Medicine, San Francisco). Radiation Research 5, 674-87(1956) Dec. II. SUPPLEMENTAL DETERMINATIONS BASED ON THE DOSE-SURVIVAL CURVES OF ESCHERICHIA COLI AND RHODOPSEUDOMONAS SPHEROIDES. Henry I. Kohn and Shirley E. Gunter (Univ. of California School of Medicine, San Francisco). Radiation Research 5, 688-92(1956) Dec. III. DETERMINATIONS BASED ON THE $LD_{10}/_{30}$ AND THE KILLING TIME OF THE MOUSE. Henry I. Kohn and Robert F. Kallman (Univ. of California School of Medicine, San Francisco). Radiation

Research 5, 693-9(1956) Dec. IV. DETERMINATIONS BASED ON THE DOSE-RESPONSE CURVES FOR TESTICULAR WEIGHT IN THE MOUSE. Henry I. Kohn and Robert F. Kallman (Univ. of California School of Medicine, San Francisco). Radiation Research 5, 700-9(1956) Dec. V. DETERMINATIONS BASED ON THE LD_{50} OF THE 4-DAY-OLD CHICK EMBRYO. Henry I. Kohn and Robert F. Kallman (Univ. of California School of Medicine, San Francisco). Radiation Research 5, 710-14(1956) Dec.

2794
PROTEOLYTIC ENZYME ACTIVITY IN IRRADIATION-STERILIZED MEAT. Maurice P. Drake, J. W. Giffee, Jr., Robert Ryer, III, and Hubert Harriman (Food Labs., QM Food and Container Inst. for the Armed Forces, Chicago, Ill.). Science 125, 23(1957). Jan. 4.

2795
EFFECT OF IONIZING RADIATION ON RUST REACTION IN PLANTS. E. A. Schwinghamer (Brookhaven National Lab., Upton, N. Y.). Science 125, 23-4(1957) Jan. 4.

Refer also to abstract 2983.

RADIATION HAZARDS AND PROTECTION

2796 AERE-HP/R-551
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
ESTIMATION OF MAXIMUM PERMISSIBLE LEVELS OF RADIATION. A. C. Chamberlain. Aug. 1950. 52p.

The evidence on which is based the maximum permissible level of 0.3 rep/week of gamma radiation to the critical tissue, corresponding to 0.5 rep/week measured at the surface of the body, is briefly summarized, and the corresponding levels for other radiations are stated. The methods of deducing the permissible levels under various conditions are indicated. The methods of deduction of permissible levels for ingested isotopes and tables for those most commonly met with are given. Finally the hazards from statistically mixed fission products are considered. (auth)

2797 AEC-tr-2679
RADIOACTIVE DECONTAMINATION OF SKIN BY IONTOPHORESIS. Georges Michon. Translated by K. S. Bevis from Compt. rend. 243, 976-8(1956). 3p.

A technique is described for decontamination of skin based on the movement of ions in an electric field applied to the skin by means of two electrodes, one of which is placed at a random point on the body and the other on the contaminated area. (C.H.)

2798
SAFEGUARDING CHILDREN FROM RADIATION RISKS. Robert W. Miller. Children (1956) Nov.-Dec.

2799
RESISTANCE OF MOUSE TISSUE SULFHYDRYL TO ALTERATIONS BY CHANGES IN DIETARY INTAKE OF SULFUR AMINO ACIDS. Lyle V. Beck and Adele M. Bianconi (Department of Physiology and Pharmacology, School of Medicine, Univ. of Pittsburgh). J. Nutrition 60, 197-210 (1956) Oct.

RADIATION SICKNESS

2800
EFFECTS OF ACUTE RADIATION SICKNESS ON THE ABSORPTION OF METHIONINE FROM THE GASTROINTESTINAL TRACT. N. M Okulov (Central Research Inst. of Roentgen-Radiology). Med. Radiol. 1, No. 5, 41-4(1956) Sept.-Oct. (In Russian)

2801
HEMOTHERAPY IN RADIATION SICKNESS. A. A. Bagdasarov, B. F. Belyaeva, and L. S. Rogachev (Central Hematology and Blood Transfusion Inst.). Med. Radiol. 1, No. 5, 45-50(1956) Sept.-Oct. (In Russian)

RADIOTHERAPY

2802
INTRACAVITARY ADMINISTRATION OF RADIOACTIVE COLLOIDAL GOLD (Au^{198}) FOR THE TREATMENT OF MALIGNANT EFFUSIONS. A REPORT OF THIRTY-ONE CASES AND AN APPRAISAL OF RESULTS. Melvin P. Osborne and Bradley E. Copeland (New England Deaconess Hospital and the Cancer Research Inst., Boston, Mass.). New England J. of Med., 255, 1122-8(1956) Dec. 13.

2803
CORRECTION FACTORS FOR TUMOR DOSE IN THE CHEST CAVITY DUE TO DIMINISHED ABSORPTION AND SCATTER IN LUNG TISSUE. Lillian E. Jacobson and Isabelle S. Knauer. Radiology 67, 863-76(1956) Dec.

TOXICOLOGY STUDIES

2804
COMPARATIVE TOXICITY OF STABLE RARE EARTH COMPOUNDS. I. EFFECT OF CITRATE COMPLEXING OF STABLE RARE EARTH CHLORIDE TOXICITY. Joseph G. Graca, Edna L. Garst, and William E. Lowry. Arch. Ind. Health 15, 9-14(1957) Jan.

2805
THE BIOLOGICAL ACTION OF INHALED BERYLLIUM SULFATE. Gerrit W. H. Schepers, Thomas M. Durkan, Anthony B. Delahant and Francis T. Creedon. Arch. Ind. Health 15, 32-58(1957) Jan.

2806
A RAPID AND SENSITIVE METHOD OF MONITORING BERYLLIUM AEROSOLS. J. J. Fitzgerald. Arch. Ind. Health 15, 68-73(1957) Jan.

TRACER APPLICATIONS

2807 UCRL-3530
California. Univ., Berkeley. Radiation Lab.
COPPER METABOLISM IN NORMAL LONG-EVANS RATS. James K. Ashikawa, Elmer R. Smith, and Harold L. Helwig. Sept. 25, 1956. 29p. Contract W-7405-eng-48. $4.80(ph OTS); $2.70(mf OTS).

2808 UR-478
Rochester, N. Y. Univ. Atomic Energy Project.
THE FATE OF POLONIUM^{210} COLLOID AND POLONIUM^{210} TAGGED SILVER PARTICLES FOLLOWING INTRATRACHEAL ADMINISTRATION TO RABBITS. P. E. Morrow and R. J. Della Rosa. Nov. 26, 1956. 23p. Contract W-7401-eng-49. $4.80(ph OTS); $2.70(mf OTS).

Intratracheal administrations of small volumes of distilled water containing either Po hydroxide colloid or Po adsorbed onto microscopic silver particles were made into 11 Dutch Pygmy rabbits. By serial sacrifice (up to 30 days) the pharmacodynamics of the suspenoids were studied in order to further elucidate the fate of submicroscopic particles placed in the lung airways. The larger

silver particles were eliminated more rapidly from the lung but no marked differences were found in the mode of redistribution of these materials despite large differences in their particle sizes. (auth)

2809

RADIOACTIVE PHOSPHORUS IN DIFFERENTIAL DIAGNOSIS OF OCULAR TUMORS. Irving Shapiro. Arch. Ophthalmology 57, 14-17(1957) Jan.

The results of isotope countings of 24 pathologically proved cases emanating from a series of 80 radioactive phosphorus determinations around the eye are reported. Techniques of anterior and posterior counts are described. Stress is laid upon the necissity for individualization of criteria of positivity. Three false negative reports are noted. Conservatism in the use of the test is suggested. (auth)

2810

THE INFLUENCE OF VITAMIN B_{12} DEFICIENCY ON THE UPTAKE OF I^{131} BY THE THYROID GLAND IN ADULT AND EMBRYONIC CHICKENS. T. M. Ferguson, J. B. Trunnell, B. Dennis, P. Wade, and J. R. Couch (College Station, Texas; Univ. of Texas; M. D. Anderson Hospital and Tumor Inst., Houston, Texas). Endocrinology 60, 28-32(1957) Jan.

2811

THE RADIOACTIVITY FROM THOROTRAST AND ITS RETENTION IN TISSUES. J. Rotblat and Gillian Ward (The Medical College of St. Bartholomew's Hospital, London). Phys. in Med. and Biol. 1, 125-37(1956) Oct.

2812

WHOLE BODY RADIOACTIVITY MEASUREMENT AS APPLIED TO CLINICAL TRACER STUDIES. J. E. S. Bradley (Postgraduate Medical School, London); N. Veall (Guy's Hospital Medical School, London) and F. Whiting (King's College Hospital and Medical School, London). Phys. in Med. and Biol. 1, 147-52(1956) Oct.

CHEMISTRY

2813 ISC-794

Ames Lab., Ames, Iowa.

ANNOTATED BIBLIOGRAPHY OF DIAMINOETHANEDIONEDIOXIME. Charles V. Banks and Richard Fullerton. Oct. 1, 1956. 14p. Contract W-7405-eng-82. $0.15(OTS).

2814 MCW-1384

Mallinckrodt Chemical Works, St. Louis.

CAUSES OF REFINERY TANK EXPLOSION ON DECEMBER 7, 1955. J. A. Kennelley, G. P. Lang, and G. L. Martin. Mar. 1, 1956. Decl. Dec. 11, 1956. 14p. Contract W-14-108-eng-8. $0.35(OTS).

Investigation established that the explosion was caused by a rapid pressure buildup from the reaction of an aliphatic cutting oil with uranyl nitrate and nitric acid. The cutting oil entered the plant with uranium sawdust and some of it remained trapped in the converted sawdust. Qualitative testing for flammability and reaction showed that many different cutting oils and lubricants would undergo the same reaction. (auth)

2815 NYO-7403

Columbia Univ., New York.

THE PREPARATION AND EVALUATION OF SUPERIOR FLOCCULATING AGENTS FOR PHOSPHATE SLIMES. Progress Report of Work from August 1, 1955—August 31, 1956. Victor K. LaMer, Robert H. Smellie, Jr., Pui-Kum Lee, and K. Ramamurti. Oct. 30, 1956. 29p. Contract AT(30-1)-1189. $0.25(OTS).

The preparation of improved flocculating agents from starches and other basic materials was studied. The effect of branching vs. linear structure of the skeleton, the effect of number and type of ionizable substituents such as COOH, $-PO_4H$, SO_3H etc., and the effect of crosslinking of polymers on their efficiency as flocculating agents for slimes were determined. Among the agents developed were various compounds prepared from PAM-100, polyacrylamide. Compounds involving various degrees of polymerization of this polyacrylamide and combinations of these polymers with various partially hydrolyzed ($CONH_2$ to COOH) samples, were prepared in attempts to produce superior flocculating agents. In addition the effectiveness of crosslinking was demonstrated. Various degrees of crosslinking were obtained by means of the formaldehyde reaction with the $-NH_2$ of the amide groups producing methylene bonds. The preliminary results exhibited by these crosslinked polymers in improving flocculation and filtration were so superior that a further investigation of the effect of crosslinking of polyacrylamides was carried out. Among the products obtained by the crosslinking of PAM-100 with formaldehyde, many proved to be excellent flocculating agents. These samples had not been specifically subjected to hydrolysis and hence the study of crosslinking without hydrolysis was made. (auth)

2816 AEC-tr-2700

THE MECHANISM OF DECOMPOSITION OF METHANE. P. S. Shantarovich and B. V. Pavlov. Translated from Zhur. Fiz. Khim. 30, 811-20(1956). 13p.

The kinetics of the homogeneous thermal decomposition of CH_4 were studied and the inhibiting effect of H in this reaction was investigated. It was shown that the homogeneous decomposition of CH_4 is a first-order reaction, proceeding by a chain mechanism through free radicals with an effective constant $k = k_3k_4/k_7$. It was further shown that the effective energy of activation found for the process as a whole (E = 85 kcal) is the actual energy of activation of the reaction ($CH_3-CH_2 + H$) as the limiting stage in the chain decomposition of CH_4. From data on the effect of H_2 on the decomposition of CH_4 was determined the energy of activation of the reaction ($CH_2 + H_2-CH_4$), equal to E_5 = 11 kcal. This value agrees with the value (assumed from previous data on the decomposition of CH_4 in diluted streams) of the energy barrier $\epsilon \approx 9$ kcal for the reaction ($CH_4-CH_2 + H_2$), and thus indicates that the primary product of the decomposition of CH_4 is the bivalent radical CH_2 arising from reaction with E_1 = 92 to 94 kcal. (auth)

2817

ISOTOPIC EXCHANGE CRITERIA FOR ENZYME MECHANISMS. D. E Koshland Jr. (Brookhaven National Lab., Upton, N. Y.). Faraday Society Discussions 20, 142-8 (1955).

Isotopic exchange reactions are evaluated as criteria for distinguishing between proposed transfer and hydrolytic enzyme mechanisms. The classic type of exchange of BX with X gives definitive results when exchange is observed and the enzyme has the appropriate specificity pattern. The exchange criterion can be extended to enzymes of low specificity or those giving no detectable exchange by a combined kinetic and thermodynamic approach. Exchanges of water with unhydrolyzed esters containing doubly-bonded oxygen can give definitive results for direct attack, but no exchange has been found in the cases tested so far. Enhancement of exchange by the presence of the second substrate can be explained by a required orientation of labile catalytic groups. (auth)

2818

REACTIONS IN SODIUM HYDROXIDE—NICKEL SYSTEM. D. M. Mathews and R. F. Kruh (Univ. of Arkansas, Fayetteville). Ind. Eng. Chem. 49, No. 1, 55-8(1957) Jan.

The current interest in high temperature systems has led to an attempt to establish the course of reaction between a metal and a hydroxide as temperatures up to 1000°C. Reactions between sodium hydroxide and nickel, carried on in vacuum at temperatures near 1000°C, have produced hydrogen, water, sodium oxide, nickel oxide, sodium nickelate, and sodium. All reactions are driven by the removal of a gaseous product, and in a closed system no net reaction occurs. (auth)

2819

URANIUM–ALUMINUM ALLOY DISSOLUTION. R. G. Wymer and R. E. Blanco (Oak Ridge National Lab., Tenn.). Ind. Eng. Chem. 49, No. 1, 59-61(1957) Jan.

Dissolution of heterogeneous nuclear reactor fuel elements is the initial step in aqueous processes for the recovery of fissionable and fertile materials. This step converts the solid fuel to a liquid process feed material. Common fuel materials such as uranium–aluminum alloy and aluminum jackets for uranium or thorium core materials are readily soluble in nitric acid catalyzed by mercuric nitrate or in sodium hydroxide solutions. Jacket removal by caustic dissolution has the advantage of selective dissolution in that the core materials remain untouched. Sodium nitrate can be added to the caustic to suppress hydrogen evolution and reduce the explosion hazard. This paper reports a study of the nitric acid and caustic systems as applied to uranium–aluminum alloy dissolution. (auth)

2820

KINETICS AND MECHANISM OF THE ACID-CATALYZED HYDROLYSIS OF SUBSTITUTED ETHYLENE OXIDES. J. G. Pritchard and F. A. Long (Cornell Univ., Ithaca, N. Y.). J. Am. Chem. Soc. 78, 2667-70(1956) June 20.

The kinetics of the acid-catalyzed hydrolysis of ten simple epoxides have been studied at 0°, by a dilatometric procedure, in aqueous perchloric acid with acid concentrations ranging up to 3.5 M. The rates vary widely with substituent; at constant acid concentration the rate for isobutylene oxide is faster than that for epibromohydrin by about 10^4. For the seven oxides whose rates could be studied in concentrated solutions of acid, log k_1 was found to increase linearly with $-H_0$. On this basis it is concluded that the hydrolysis goes by an A-1 mechanism involving a carbonium ion intermediate. This conclusion is supported by evidence from several other sources. (auth)

2821

DEGRADATION OF POLYPHOSPHATES IN SOLUTION. I. KINETICS AND MECHANISM OF THE HYDROLYSIS AT BRANCHING POINTS IN POLYPHOSPHATE CHAINS. Ulrich P. Strauss and Theodore L. Treitler (State Univ., N. J. and Rutgers Univ., New Brunswick, N. J.). J. Am. Chem. Soc. 78, 3553-7(1956) Aug. 5.

Previous kinetic studies of the rapid hydrolysis of branching points in sodium polyphosphate have been extended. From the first-order rate constants, measured both titrimetrically and viscosimetrically at 0, 25 and 45°, an activation energy of 18.9 kcal. per mole was calculated. Lowering the polarity of the aqueous solvent by the addition of organic solvents had no significant effect on the rate. Several conceivable hydrolysis mechanisms are examined and, of these, only the mechanism involving a nucleophilic attack of a water molecule on the branch point phosphorus atom followed by a breakdown of the transition state into two polyphosphate chains is consistent with the known experimental data. Consequences of a similar nucleophilic mechanism operating in the case of the degradation of linear protions of polyphosphate chains are discussed and found to be in qualitative accord with published results. Further conclusive evidence is presented that the rapid initial hydrolysis of Graham's salts occurs at branch points in the polyphosphate chains. (auth)

2822

ISOTOPIC EXCHANGE BETWEEN $SnCl_4$ AND 2-CHLOROBUTANE. Reed A. Howald and John E. Willard (Univ. of Wisconsin, Madison). J. Am. Chem. Soc. 78, 6217-20(1957) Jan. 5.

The homogeneous exchange of Cl^{36} between $SnCl_4$ and 2-chlorobutane occurs at a measurable rate in heptane solution at 140° and faster at 160°. In heptane at room temperature exchange was observed only in the presence of HCl and of the white solid which is formed when water is added to $SnCl_4$. The data on the homogeneous exchange appear to be most consistent with a mechanism involving formation of a rather stable ($SnCl_4 \cdot C_4H_9Cl$) complex. (auth)

2823

A COMPARISON OF PYCNOMETRIC AND X-RAY DENSITIES FOR THE SODIUM CHLORIDE–SODIUM BROMIDE AND POTASSIUM CHLORIDE–POTASSIUM BROMIDE SYSTEMS. John S. Wollam and W. E. Wallace (Univ. of Pittsburgh, Penna.). J. Phys. Chem. 60, 1654-6(1956) Dec.

Pycnometric and x-ray densities are presented for seven NaCl–NaBr and two KCl–KBr solid solutions, and for NaCl, NaBr, and KCl. Discrepancies found were in general smaller than had been found in earlier comparisons of x-ray and directly determined densities of alkali halide solid solutions. The discrepancies for the solid solutions are, however, in almost all cases larger than for the pure salts suggesting the existence of a greater number of lattice defects in the solutions than in the pure components. (auth)

ANALYTICAL PROCEDURES

2824 HW-32843(Rev.)

Hanford Atomic Products Operation, Richland, Wash. SPECTROCHEMICAL DETERMINATION OF URANIUM ISOTOPES. J. L. Daniel. Aug. 26, 1954. Decl. Feb. 23, 1956. 20p. Contract W-31-109-Eng-52. $3.30(ph OTS); $2.40(mf OTS).

Methods for the spectrochemical determination of U^{235} in natural or depleted uranium are described. A precision of about 5 per cent standard deviation is obtained with a spectrograph, and about 2 per cent with a direct reading spectrometer. Studies show that improvement in precision would probably result if a spectrograph or spectrometer having greater dispersion and resolving power were used. (auth)

2825 HW-39110

Hanford Atomic Products Operation, Richland, Wash. THE COULOMETRIC TITRATION OF PLUTONIUM. W. N. Carson, Jr., H. S. Gile, and J. W. Vanderwater. Sept. 8, 1955. Decl.May 1, 1956. 37p. Contract W-31-109-Eng-52. $6.30(ph OTS); $3.00(mf OTS).

It was shown that a coulometric titration based on the preliminary oxidation of the Pu to PuO_2^{2+} followed by titration with electrolytically-generated Fe^{2+} to Pu^{4+} was such a general method and was subject to few interferences. The method can be used for samples containing 3 μg ot 10 mg of Pu. The precision expressed as the standard deviation of a single result is about 5% at the 3 μg level, and about 1% at the 1 mg level. Both manual and automatic procedures were studied and found suitable for the entire range of sample size. Simple modifications in the procedures overcome the few interferences for the method. The significance of the work is that a chemical determination of Pu can be made for amounts of Pu heretofore determined only by radioassay methods, and the chemical determination of larger amounts are made more readily and

with higher precision than with previous methods. The work also extends the application of coulometric titration methods to a new substance. (auth)

2826 IDO-14316(Suppl. 1)
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
SUPPLEMENT NO. 1 TO MANUAL OF THE ANALYTICAL METHODS USED BY THE CONTROL LABORATORY AT THE CHEMICAL PROCESSING PLANT. PARTS I AND II. M. J. Shepherd, Jr. and J. E. Rein. Nov. 1956. 163p. Contract AT(10-1)-205.

2827 IDO-14389
Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho.
DETERMINATION OF SMALL AMOUNTS OF CHLORIDE IN HIGH NICKEL–CHROMIUM–IRON SOLUTIONS. Kenneth W. Puphal, Glenn L. Booman, and James E. Rein. Nov. 28, 1956. 10p. Contract AT(10-1)-205. $0.20(OTS).

Turbidimetric measurement of colloidal AgCl is reliable for the determination of small amounts of chloride in samples containing high concentrations of Fe^{3+}, Cr^{3+}, Ni^{2+}, Al^{3+}, UO_2^{2+}, HNO_3, and HF and low levels of Nb^{5+}. Fifty percent by volume ethylene glycol is the recommended media. At the working wavelength of 475 mμ, the optical absorbance from the diverse ions is a minimum and is linear with chloride concentrations. For sample aliquots containing 5×10^{-3} mg of chloride, the precision is better than 20% standard deviation and is 1.2% at the 0.1-mg level. (auth)

2828 ISC-667
Ames Lab., Ames, Iowa.
I. DIRECT TITRATION OF SULFATE. II. HIGH PRECISION SPECTROPHOTOMETRIC ANALYSIS. Max Q. Freeland and J. S. Fritz. Nov. 28, 1955. 68p. Contract W-7405-eng-82. $0.40(OTS).

A method is proposed in which SO_4^{2-} is titrated directly with standard Ba solution. The end point is indicated by the adsorption of Alizarin Red S or Thorin onto the $BaSO_4$ with a distinct color change from yellow to pink. The SO_4^{2-} sample must contain 30 to 40% methanol for these indicators. Coprecipitation errors are greater than for gravimetric SO_4^{2-} methods, but most of these can be avoided by the preliminary removal of cations with an ion exchange column. In the absence of interfering anions, the ion exchange-titrimetric method is as precise as the gravimetric method and considerably faster. A complete review of literature on titrimetric SO_4^{2-} determination is included with bibliography. The experimental work leading to the proposed method is detailed and discussed. These procedures were applied to the analysis for V in three V–Al alloys. The accuracy obtained on synthetic samples averaged 0.1%. The reproducibility on the actual samples averaged better than 0.2%. (auth)

2829 LA-1394
Los Alamos Scientific Lab., N. Mex.
THE SPECTROPHOTOMETRIC DETERMINATION OF URANIUM. A. L. Henicksman. Mar. 15, 1952. Decl. Nov. 7, 1955. 27p. Contract W-7405-eng-36. $4.80(ph OTS); $2.70(mf OTS).

Measurement of the color intensity of the U thiocyanate complex is discussed as a method for the quantitative determination of U. Two procedures for amounts from 1 microgram to 1 milligram are described, and standard curves are shown. The effects of numerous foreign ions are shown, and methods of removal for some of these are discussed. (auth)

2830 MLM-21(Del.)
Monsanto Chemical Co., Dayton, Ohio.
THE COLORIMETRIC DETERMINATION OF SILVER IN VERY LOW CONCENTRATIONS IN BISMUTH. John H. Payne, Jr. Feb. 16, 1948. Changed from OFFICIAL USE ONLY with deletions July 31, 1956. 14p. Contract AT-33-1-GEN-53. $3.30(ph OTS); $2.40(mf OTS).

Procedures for the determination of Ag in Bi using cupric dithizonate as a colorimetric reagent are presented. (W.L.H.)

2831 TID-5002
[Manhattan District, Oak Ridge, Tenn.].
TRANSURANIC ELEMENTS: ANALYTICAL CHEMISTRY. Paul L. Kirk and C. J. Rodden. [1947?]. TIS issuance date Nov. 1954. Decl. July 23, 1956. 57p.

A detailed discussion is presented of the analytical procedures and equipment devised for the determination of Pu under all conditions and in many mixtures. Indications of variations encountered with transuranic elements other than Pu and their effects on analytical determination are given. (J.E.D.)

2832 WIN-43
National Lead Co., Inc. Raw Materials Development Lab., Winchester, Mass.
THE DIRECT SPECTROPHOTOMETRIC DETERMINATION OF URANIUM IN SULFATE AND CARBONATE SOLUTIONS. Bernard W. Wessling and Michael A. DeSesa. June 18, 1956. 12p. Contract AT(49-6)-924.

A spectrophotometric method of analysis for U based on the absorption of ultraviolet light by UO_2SO_4 and carbonate complexes is described. The method has been used to provide accurate, rapid analyses of uraniferous solutions used in batch and column ion exchange loading tests. (auth)

2833 AEC-tr-2699
IDENTIFICATION AND DETERMINATION OF GLUCOSAMINE AND GALACTOSAMINE BY PAPER CHROMATOGRAPHY. G. F. Fischer and Hans Joachim Nebel. Translated from Hoppe-Seyler's Z. physiol. Chem. 302, 10-19 (1955). 21p.

Glucosamine and galactosamine are sharply separated from each other and from other saccharides by means of paper chromatography so that it is possible to identify and estimate them quantitatively by reduction of triphenyltetrazolium hydroxide. The estimation also gives correct results with hydrolysates from materials containing proteins and polysaccharides. The hydrolysis of substances containing hexosamines and the preparation of the hydrolysates for the chromatography are further investigated. (auth)

2834
CHRONOPOTENTIOMETRIC ANALYSIS IN FUSED LITHIUM CHLORIDE — POTASSIUM CHLORIDE. H. A. Laitinen and W. S. Ferguson (Department of Chemistry and Chemical Engineering, Univ. of Illinois, Urbana). Anal. Chem. 29, 4-9(1957) Jan.

Salts dissolved in high temperature molten systems may be studied by chronopotentiometry. Using platinum electrodes, measurements made on the chlorides of Bi^{3+}, Cd^{2+}, Ag^+, and Cu^+ in a LiCl-KCl eutectic mixture at 450° showed the theoretical relationship among applied current density, concentration, and transition time. The chronopotentiometric method of analysis is capable of accuracy of the order of ±2.6% using electrodes without linear constraint. (auth)

2835
INDIRECT FLAME PHOTOMETRIC METHOD FOR DETERMINATION OF HALIDES. Oscar Menis, H. P. House and T. C. Rains (Oak Ridge National Lab., Tenn.). Anal. Chem. 29, 76-9(1957) Jan.

Very low concentrations of halogens can be determined by their effect on the intensity of the flame of a standard silver solution at 328 mμ. The AgCl is removed by centrifugation. Precision is of the order of 5% in the range 1 to

10 γ of chloride. By masking with NH_4OH; iodide can be determined in the presence of chloride and bromide, and also bromide in the presence of chloride. As many as 20 samples can be analyzed in one hour. (auth)

2836

TITRATION OF SULFATE FOLLOWING SEPARATION WITH ALUMINA. James S. Fritz, Stanley S. Yamamura and Marlene Johnson Richard (Inst. for Atomic Research and Department of Chemistry, Iowa State College, Ames). Anal. Chem. 29, 158-61(1957) Jan.

Sulfate in the presence of large amounts of salts may be determined titrimetrically if first absorbed on an alumina column to separate from cations and most other anions. The sulfate is eluted with ammonium hydroxide, passed through a cation exchanger, and titrated with 0.01 M barium perchlorate. Sulfur in organic compounds is determined after a peroxide bomb combustion. (auth)

2837

NON-FERROUS METALLURGICAL ANALYSIS—A REVIEW. G. W. C. Milner (Atomic Energy Research Establishment, Harwell, Berks, England). Analyst 81, 619-50 (1956) Nov.

2838

THE HAHN EMANATION TECHNIQUE USING TELLURIUM–IODINE-132. G. B. Cook and E. W. Prout (Atomic Energy Research Establishment, Harwell). J. Inorg. Nuclear Chem. 3, 255-62(1956) Nov.

The emanation technique has been studied using iodine 132, which grows from tellurium 132, as the volatile component instead of the more usual radium-emanation system. Good agreement was obtained between the results, using iodine and emanation in a study of the heating of barium sulfate. When the method was applied to potassium and sodium sulfate, the results were less decisive. (auth)

2839

NEW METHOD OF DETERMINING U, Ra, Th, AND Ac IN FINE PARTICLES OF RADIOACTIVE ORE. G. Becquerel. J. Phys. Radium 17, Suppl. 137A-42A(1956) Nov.

A method is described which allows the simultaneous determination of U, Ra, Th, and Ac in a very fine particle of radioactive ore. The determination is made by studying the absorption of α rays or by equivalent screens and in applying the results obtained to the observation of the recrossing curve of the active deposits in the sample after prolonged heating to 800°C. The sensitivity of the method allows the study of fine particles of ores emitting one α ray per second. (tr-auth)

2840

AN AUTOMATIC ANALYSER OF URANIUM CONTENT IN PROCESS STREAMS. H. Bisby and L. H. Brown (Atomic Energy Research Establishment, Harwell, Berks) and D. R. Chapman (Baird and Tatlock (London) Ltd., Chadwell Heath, Essex). J. Sci. Instr. 33, 467-75(1956) Dec.

The instruments described employ an absorptiometric technique for the determination of uranium-ion concentrations in aqueous solutions. Contemporary batch samples are taken in cyclic order from process streams, separately treated with aqueous ammonium thiocyanate, and the resulting color complexes are analysed by an ultra-violet absorptiometer at 3650 A. The cycle of events is entirely automatic and a permanent record of the uranium-ion concentration of the individual streams is produced. A four-point general-purpose analyser and a sixteen-point analyser for low (0.005 g/l) concentrations of uranium are described in detail. The instrumental techniques evolved have wider applications in automatic chemical analysis. (auth)

2841

THE SPECTROGRAPHIC ANALYSIS OF ALPHA-ACTIVE MATERIALS BY THE COPPER SPARK METHOD. F. T. Birks (Atomic Energy Research Establishment, Harwell, Didcot, Berks). Spectrochim. Acta 8, 167-79(1956) Sept.

The active samples are sparked in a disposable plastic cassette which is enclosed in a secondary chamber. The excitation source is a 30,000-volt high-wattage generator of the Feussner type, with Tl^{204} sources in place of the usual mercury lamp to ionize the synchronous interrupter gap. The spark source and the spectrograph are housed in separate laboratories; the light passing through a quartz window and reflecting from a mirror into the spectrograph. Four micrograms of molybdenum are added as the internal standard. The line ratios and working curves are given for fourteen elements and the detection sensitivities are given for thirty-eight impurity elements. The coefficient of variation of the estimations is from 5 to 10% at the five-microgram level. (auth)

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

2842

DIRUBIDIUM URANYL TETRANITRATE, $Rb_2UO_2(NO_3)_4$. Eugene Staritzky and Donald I. Walker (Los Alamos Scientific Lab., New Mexico). Anal. Chem. 29, 164-5(1957) Jan.

2843

TETRAHYDROGEN TRIPOTASSIUM THORIUM HENDECANITRATE $H_4K_3Th(NO_3)_{11}$. R. M. Douglass (Los Alamos Scientific Lab., New Mexico). Anal. Chem. 29, 165-6(1957) Jan.

FLUORINE AND FLUORINE COMPOUNDS

2844 NP-6167

Battelle Memorial Inst., Columbus, Ohio.

POLYMERIZATION STUDIES ON MONOMERS AND EVALUATION OF DERIVATIVE POLYMERS. Quarterly Progress Report No. 3 [for] September 1 to December 1, 1956. F. B. Jones, C. A. Lichtenwalter, P[almer] B. Stickney, and R. G. Heiligmann. Dec. 1, 1956. 46p. Project No. 6(8-7340).

Investigations were made of the copolymerization of perfluoropropylpropenyl ketone with butadiene and a series of halogenated butadienes. (For preceding period see NP-6090.) (W.L.H.)

MOLECULAR STRUCTURE

2845

IONIZATION POTENTIALS AND THE CHEMICAL BINDING AND STRUCTURE OF SIMPLE INORGANIC CRYSTALLINE COMPOUNDS—I. CHEMICAL BINDING. D. F. C. Morris (New College, Oxford) and L. H. Ahrens (Department of Geology and Mineralogy, Oxford). J. Inorg. Nuclear Chem. 3, 263-9(1956) Nov.

The differences in the bond character of simple inorganic crystalline compounds are considered in terms of ionic interaction. The ionization potentials I of the electropositive constituents (first ionization potential for oxidation number +1, second ionization potential for oxidation number +2, etc.) are taken as a measure of the relative electrostatic field strengths of the respective cations. In the case of crystals regarded as formed through the interaction of cations of the same formal charge and similar (crystal) radius with a given anion, it is shown that the bonding appears to possess greater covalent character the greater

the value of I. The variations in the nature of bonding with I are correlated with lattice energies, interatomic distances, and color, and also with magnetic, structural, and microwave data. (auth)

2846

IONIZATION POTENTIALS AND THE CHEMICAL BINDING AND STRUCTURE OF SIMPLE INORGANIC CRYSTALLINE COMPOUNDS—II. CRYSTAL STRUCTURE. L. H. Ahrens (Department of Geology and Mineralogy, Oxford) and D. F. C. Morris (New College, Oxford). J. Inorg. Nuclear Chem. 3, 270-80(1956) Nov.

Inorganic crystalline compounds, whether structurally ionic or not, are considered as formed via an ionic stage. The structures are interpreted in the light of the properties of the interacting cations and anions. In the case of cations, the magnitude of their effective electrostatic field strengths is considered an important property. The importance of the polarizabilities of ions and their relative sizes in determining structures is also discussed. As a measure of the relative electrostatic field strengths of cations, ionization-potential values I (first for univalent cations, second for divalent cations, etc.) are employed. In the case of crystals regarded as formed through the interaction of cations of the same formal charge and similar (crystal) radius with a given anionic constituent, it is shown that there are certain threshold values of I which serve to divide ionic from nonionic structures. Within the nonionic structure ranges there is evidence of fairly regular variations in structure with increase in ionization potential, until at very high I values instability might result. (auth)

RADIATION CHEMISTRY

2847

X- AND γ IRRADIATION OF FERROUS SULFATE IN DILUTE AQUEOUS SOLUTION. J. L. Haybittle, R. D. Saunders, and A. J. Swallow (Univ. of Cambridge, England). J. Chem. Phys. 25, 1213-17(1956) Dec.

The yield for the x- and γ-ray induced oxidation of Fe^{2+} in acid aqueous solution has been determined for x- and γ rays of effective mean energies from 21 kev to 7.6 Mev. For 60 kvp x-rays of effective mean energy, $\bar{E}$, 21 kev, $G = 13.1 \pm 0.5$ Fe^{3+} produced per 100 ev absorbed; for 100 kvp x-rays ($\bar{E}$ = 33 kev) $G = 14.7 \pm 0.5$; for 220 kvp x-rays ($\bar{E}$ = 56 kev), $G = 15.0 \pm 0.5$; for Co^{60} γ rays ($\bar{E}$ = 1.25 Mev), $G = 15.5 \pm 0.5$; and for 30 Mev x-rays ($\bar{E}$ = 7.6 Mev), $G = 16.3 \pm 0.6$. In each case the energy absorbed in the solution was estimated by means of an ionization chamber. (auth)

2848

RADIATION-INDUCED OXIDATION OF ACETIC ACID-OXYGEN SOLUTIONS. Warren M. Garrison, Herman R. Haymond, Winifred Bennett, and Sibyl Cole (Univ. of California, Berkeley). J. Chem. Phys. 25, 1282(1956) Dec.

2849

NUCLEAR MAGNETIC N^{14} RESONANCE SPECTRA, MOLECULAR STRUCTURES, AND EXCHANGE REACTIONS IN THE SYSTEM $N_2O_5-NO_2^+-NO_3^--H_2O$. Richard A. Ogg, Jr. and James D. Ray (Stanford Univ., California). J. Chem. Phys. 25, 1285-6(1956) Dec.

2850

NITROGEN ISOTOPIC FRACTIONATION BETWEEN NO AND NO_2 AND MASS DISCRIMINATION IN MASS ANALYSIS OF NO_2. G. M. Begun and C. E. Melton (Oak Ridge National Lab., Tenn.). J. Chem. Phys. 25, 1292-3(1956) Dec.

RARE EARTHS AND RARE-EARTH COMPOUNDS

2851 ISC-659

Ames Lab., Ames, Iowa.

REACTIONS OF CERIUM AND LANTHANUM WITH CERAMIC OXIDES. George R. Pulliam and Elmer S. Fitzsimmons. July 1955. 63p. Contract W-7405-eng-82.

The surface properties of Ce and La metals were determined for the metals melted on refractory oxide plaques of Al_2O_3, BeO, ThO_2, and stabilized ZrO_2. The reactions occurring at the interface between the metals and the refractories were also determined by metallographic and x-ray techniques. The surface tension, contact angle, and work of adhesion were determined at temperatures of 810, 900, and 1000°C for Ce, and at temperatures of 950, 1000, 1100 and 1200°C for La. The metallographic examination of the reactions was conducted on polished sections of the interfaces. The temperatures to which the specimens were subjected for this phase of the study were 1100°C for Ce and 1200°C for La. To aid in the microscopic examination of the reactions between Ce and the oxides, mixtures of metal and ceramic powders were heated to temperatures of 500 and 804°C for Ce. Lanthanum and oxide powders were given a similar treatment to temperatures of 600 and 924°C. X-ray diffraction patterns of the mixtures were then obtained for the identification of the phases produced from the reactions. (auth)

2852

COLOR CENTERS AND LUMINESCENCE IN SINGLE CRYSTALS OF LANTHANUM TRICHLORIDE CONTAINING DIPOSITIVE EUROPIUM. Dieter M. Gruen (Argonne National Lab., Lemont, Ill.) and John G. Conway and Ralph D. McLaughlin (Univ. of California Radiation Lab., Berkeley). J. Chem. Phys. 25, 1102-11(1956) Dec.

2853

VARIATION OF THE PARAMETERS OF ELECTROSTATIC INTERACTION F_k DERIVED FROM ABSORPTION SPECTRA OF LANTHANIDE COMPLEXES. Chr. Klixbüll Jørgensen. Kgl. Danske Videnskab. Selskab., Mat.-fys. Medd. 30, No. 22, 1-38(1956).

The narrow f^n-absorption bands of Pr(III), Nd(III), Sm(III), and Gd(III) are shown to be shifted ~1% towards lower wave numbers in anion complexes, compared to the aquo ions. This effect is interpreted as a decrease of the parameters F^k of electrostatic interaction between electrons in a partly filled shell. The ratios $F^2:F^4$ and $F^4:F^6$ are not freely adjustable, but slightly depend on the radial wave function. It is possible to extrapolate from the values of F^k to the average radius r_0 of the partly filled shell, which is somewhat smaller than the ionic radii of trivalent lanthanides. The decrease of F^k is shown to be caused by partly covalent bonding. The broad 4f → 5d transitions of Ce(III), which occur at lower wave number in the aquo ion than in gaseous Ce^{+3} is further shifted in anion complexes where the crystal field also gives varying splittings of 5d. A weak band of the Ce(III) aquo ion possibly originates from a rare geometrical configuration. The absorption spectra of $CeCl_3$ in C_2H_5OH and HCl are reported, and the complex equilibria discussed. (auth)

SEPARATION PROCEDURES

2854 AECD-3738

Armour Fertilizer Works, Bartow, Fla.

RECOVERY OF URANIUM FROM WET PROCESS PHOSPHORIC ACID. Final Report. Patrick J. Quinn. Oct. 1954. Decl. with deletions May 31, 1956. 40p. Contract AT(49-1)-532. $6.30(ph OTS); $3.00(mf OTS).

The state of reduction of wet process phosphoric acid determines largely the extractability of its U content. The economic relationships involved over a wide range of reduction of the acid is defined. Reductant consumption, penalties and capital investment as well as solvent consumption are evaluated. The data presented indicate that it is economically advantageous to reduce the acid to about 210 mv and reduction below 150 mv is not feasible. If the acid is not reduced, solvent consumption is prohibitive; at about 170 mv, cost of iron addition becomes the controlling factor; at about 150 mv the efficiency of the iron as a reducing agent drops profoundly; at about 150 mv the solvent reaches peak efficiency. On either side thereof, efficiency decreases rapidly. (auth)

2855 CF-57-1-5
Oak Ridge National Lab., Tenn.
EXTRACTION OF THE ELEMENTS WITH TRIS-2-ETHYLHEXYL- AND TRIHEXYLPHOSPHINE OXIDES FROM ACIDIC SOLUTIONS. J. C. White. Jan. 2, 1957. 7p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

2856 DOW-152
Dow Chemical Co. Western Div., Pittsburg, Calif.
PROGRESS REPORT [FOR] NOVEMBER–DECEMBER 1956. Research Dept. R. H. Bailes. Jan. 1, 1957. 35p. Contract AT-30-1-GEN-236. $6.30(ph OTS); $3.00(mf OTS).

Investigations of the chemistry of new methods of production of high-grade U products directly from process liquors are reported. Equations are derived which describe the equilibrium curves found for U extraction with amines and TBP from HCl solutions involved in these purification processes. Successful application of Na_2CO_3 stripping to HDPA extracts is described. (For preceding period see DOW-149.) (auth)

2857 ISC-638
Ames Lab., Ames, Iowa.
RECOVERY OF URANIUM FROM SLAG FROM THE ELECTRIC FURNACE PRODUCTION OF PHOSPHORUS. H. Z. Cammack and G. L. Bridger. Aug. 1955. 90p. Contract W-7405-eng-82. $0.50(OTS).

The present investigation included thermal reductions of electric furnace slags with alkaline earth metals, high temperature liquid-liquid extraction with molten extractants, solubilizing fusions, magnetic separations, and leaching with various solutions. As an adjunct to the high temperature liquid-liquid extraction studies, the solubility of U in Sb, Bi, Pb, Ag and Sn were further studied, to corroborate and extend existing data. Radioassay methods of analysis were developed for the raw furnace slags and residues from the various experimental treatments. A fraction of the slag residues were checked for U using a colorimetric procedure. All binary alloys resulting from the U solubility study were analyzed with colorimetric procedures developed during the course of the investigation. (auth)

2858 ORNL-1914(Del.)
Oak Ridge National Lab., Tenn.
RAW MATERIALS PROCESS TESTING PROGRAM SEMI-ANNUAL PROGRESS REPORT [FOR] JULY 1, 1954 TO DECEMBER 31, 1954. K. O. Johnsson, ed. Dec. 3, 1956. 50p. Contract W-7405-eng-26. $0.35(OTS).

The amine extraction process utilizes a 0.1 molar solution of a high molecular weight secondary amine dissolved in an organic solvent such as kerosene as the U extraction agent. The work on this process may be summarized as follows: The technical feasibility of the process was demonstrated in a complete test array under continuous flow conditions. The results of the extraction studies showed that, over the range of compositions that cover most domestic ores, a satisfactory U concentrate was produced with greater than 99.9% recovery of U in a small test array using only four mixer-settlers in the extraction section and two in the stripping section. Rohm and Haas EB765-2 and Armeen 2-12 were the only amines tested as U extraction agents. Both are secondary amines and both were suitable agents for extraction of U from H_2SO_4 leach liquors. The results of preliminary studies on the slurry extraction process showed that an organic to aqueous phase ratio of 4:1 or greater was necessary to prevent the formation of a stable emulsion. About 97% of the U was extracted from the slurry with a 0.1 molar soln. of di(2-ethylhexyl) phosphoric acid in kerosene after 40 seconds of contacting in batch tests. The principal problem was found to be the relatively high entrainment of organic in the slurry raffinate. (auth)

2859 ORNL-2212
Oak Ridge National Lab., Tenn.
PROCESS TEST SECTION PROGRESS REPORT FOR JUNE 1956. A. D. Ryon and K. O. Johnsson. Dec. 27, 1956. 12p. Contract W-7405-eng-26. $0.15(OTS).

Samples of Marysvale and Temple Mountain ores were roasted to determine if this would improve the uranium leaching from these ores. Roasting the Marysvale ore resulted in a significant improvement in leaching efficiency but the uranium leaching of Temple Mountain ore did not appear to be affected under the conditions of the test. Studies were completed on the effect of some of the mixing variables on the extraction of uranium from 30, 40, and 50% Utex slurry by the Dapex process. Phase ratio, feed throughput, mixer speed, and turbine diameter were studied to determine their effect on both the extraction efficiency and the primary and final entrainment of the extractant phase in the raffinate stream. (auth)

2860 ORNL-2213
Oak Ridge National Lab., Tenn.
PROCESS TEST SECTION PROGRESS REPORT FOR JULY 1956. A. D. Ryon and K. O. Johnsson. Dec. 28, 1956. 14p. Contract W-7405-eng-26. $0.20(OTS).

Batch kinetic studies were made of the stripping step using sodium carbonate in a Dapex process for the recovery of uranium from leach liquors. The data are treated in the manner of Hixon and Smith to yield a reaction rate constant which is directly proportional to holdup time. It was found that the rate constant for this system is inversely proportional to the sodium carbonate excess in the stripping solution and to the power input to the mixing vessel. (For preceding period see ORNL-2212.) (auth)

2861 RMO-2850
Blockson Chemical Co., Joliet, Ill.
URANIUM RECOVERY FROM WET PROCESS PHOSPHORIC ACID. Emil M. Stoltz, Jr. Feb. 23, 1953. Decl. May 3, 1956. 45p. Contract AT(49-1)-606. $7.80 (ph OTS); $3.30(mf OTS).

A process for the recovery of U from Florida phosphate rock analyzing 0.01% U_3O_8 was developed. It consists of oxidizing H_3PO_4 with Cl, converting the H_3PO_4 to monosodium phosphate liquor, reducing and precipitating the U from the liquor with $Na_2S_2O_4$, recovering the precipitated U, leaching the U from the precipitate with dilute H_2SO_4 and $NaClO_3$, precipitating the U at 3.15 pH, and filtering and drying the precipitate. The finished product should analyze 50% U_3O_8 and 60 to 70% of the U should be recovered. A general summation of all research carried out under the contract is included. (auth)

2862

COPRECIPITATION OF RADIUM WITH BARIUM SULFATE. Louis Gordon (Syracuse Univ., N. Y.) and Keith Rowley (Brookhaven National Lab., Upton, N. Y.). Anal. Chem. 29, 34-7(1957) Jan.

Precipitation from homogeneous solution is a useful technique for distribution studies in solid-liquid systems because it permits close control of the precipitation rate. Coprecipitation of radium with barium sulfate is studied in solutions where the barium sulfate is precipitated by the hydrolysis of sulfamic acid. Distribution of radium between the aqueous and solid phases follows the laws of Doerner and Hoskins. (auth)

2863

COPRECIPITATION STUDIES WITH FERRIC PERIODATE PRECIPITATED FROM HOMOGENEOUS SOLUTION. Louis Gordon and Leonard Ginsburg (Department of Chemistry, Syracuse Univ., N. Y.). Anal. Chem. 29, 38-45(1957) Jan.

Precipitation of ferric periodate from homogeneous solution by hydrolysis of acetamide is used to study the coprecipitation of Al, Y, and Zn. In the case of Al and Y, coprecipitation is slight until 99.9% of the iron has been precipitated. Zinc shows considerable coprecipitation prior to the end of the Fe precipitation. Occlusion during the formation of the precipitate can be a negligible part of the over-all coprecipitation process. (auth)

2864

SEPARATION OF IRON FROM ALUMINUM BY PRECIPITATION OF FERRIC PERIODATE FROM HOMOGENEOUS SOLUTION. Leonard Ginsburg, Kay Millar, and Louis Gordon (Department of Chemistry, Syracuse Univ., N. Y.). Anal. Chem. 29, 46-8(1957) Jan.

Iron can be separated from Al by precipitation as ferric periodate from homogeneous solution. Precipitation results from hydrolysis of acetamide in a very dilute HNO_3 or H_2SO_4 solution of ferric ion and periodic acid. In contrast to many iron precipitates, this precipitate is dense and easily filtered. In HNO_3 85 mg. of Fe can be separated from 10 mg. of Al by a single precipitation, and from 100 mg. of Al by a "two stage" precipitation. (auth)

2865

SEPARATION AND DETERMINATION OF MICROGRAM AMOUNTS OF MOLYBDENUM. Glenn R. Waterbury and Clark E. Bricker (Los Alamos Scientific Lab., N. M.). Anal. Chem. 29, 129-35(1957) Jan.

Microgram amounts of Mo in Pu alloys can be determined by the color reaction with chloranilic acid. Molybdenum is extracted from HCl-HF solution with hexone and back-extracted with water. Iron is removed by precipitation with sodium hydroxide. Color is developed in 1.4M perchloric acid and measured at 350 mμ. Only Sn, W, and Bi interfere seriously. The average recovery of known amounts of Mo was 99.8% with a standard deviation of 1.6%. (auth)

2866

FILTRATION-PRECIPITATION SEPARATION OF BARIUM-140 FROM LANTHANUM-140. R. W. Perkins (General Electric Co., Richland, Wash.). Anal. Chem. 29, 152-3 (1957) Jan.

Carrier free Ba^{140} can be rapidly separated from its daughter, La^{140}, by filtering through an anion [OH-] column. Lanthanum-140 is precipitated on the resin and Ba^{140} passes through in the effluent. Lanthanum-140 can be removed from the resin by acid elution. Both have a high radiochemical purity. (auth)

2867

SPRAY LIQUID-LIQUID EXTRACTION COLUMNS. PREDICTION OF LIMITING HOLDUP AND FLOODING RATES. J. D. Thornton (United Kingdom Atomic Energy Authority, Harwell, Didcot, Berkshire). Chem. Eng. Sci. 5, 201-8 (1956) Aug.

The dispersed phase holdup for spray columns can be related to the phase flow rates by the following equation: $(V_d/x) + (V_c/1-x) = \epsilon \bar{v}_0(1-x)$. In this expression, $\bar{v}_0$ is the characteristic velocity identified as the mean relative velocity of the droplets extrapolated to essentially zero flow rates. Differentiation of the above equation, treating x as the independent variable gives expressions which have been used to correlate flood point data in terms of $\bar{v}_0$. It has also been shown that the limiting holdup at the flood point is dependent only on the phase flow ratio and is independent of the physical properties of the system. In the case of spray columns, it has been found possible to predict $\bar{v}_0$ on the basis of the normal correlation of the free falling velocity for spheres, assuming the droplet size to be given by Hayworth and Treybal's relationship. The entire flooding curve can thus be predicted for any system in terms of its physical properties and the dispersed phase nozzle geometry. (auth)

2868

EXTRACTION OF URANYL NITRATE WITH ORGANIC SOLVENTS. II. WITH TRI-N-BUTYL PHOSPHATE. A. Cacciari, R. De Leone, C. Fizzotti and M. Gabaglio (Laboratori CISE, Milano). Energia Nucleare (Milan) 3, 368-75(1956) Oct. 15. (In Italian)

Studying the extraction of uranyl nitrate with tributylphosphate diluted with white spirit, the dependence from tributylphosphate concentration is determined and the equilibrium curve for a 40% concentration in volume of tributylphosphate is drawn. The influence of nitric acid and ammonium nitrate under these very conditions is examined. Besides the equations for the equilibrium curves, the extraction of nitric acid in presence of uranyl nitrate and ammonium nitrate and the influence of phosphates are considered. Also the partition coefficients of iron and copper are measured. (auth)

2869

SEPARATION OF PROTACTINIUM FROM URANIUM RESIDUES. Murrell L. Salutsky, Kenneth Shaver, Andrew Elminger, and Mary Lou Curtis (Mound Lab., Miamisburg, Ohio). J. Inorg. Nuclear Chem. 3, 289-95(1956) Nov.

The chemistry of protactinium has recently become of interest in nuclear reactor technology. Weighable quantities of protactinium-231 were needed for investigations of its chemistry. A survey showed that one of the best sources of protactinium was a residue obtained in the processing of uranium minerals. This residue, which exists in tonnage quantities, contains a protactinium concentration of 0.1 to 0.3 part per million as determined by gamma-spectrum analysis. A relatively inexpensive method is described for the recovery of more than 90% of the protactinium in a high degree of purity. (auth)

2870

FIRST EXPERIMENT OF THE DOUBLE MONOCHROMATOR IN THE ELECTROMAGNETIC SEPARATION OF ISOTOPES. Charles Gassignol. J. Phys. Radium 17, Suppl. 113A-15A (1956) Nov.

After having enumerated the causes capable of limiting the enrichment in isotopic separations, an electrostatic apparatus using double monochromation is described. The first results show a gain of an order of magnitude of the coefficient of enrichment with respect to ordinary separations. (tr-auth)

2871

THE PURIFICATION OF URANIUM REACTOR FUEL BY LIQUID—METAL EXTRACTION. A. F. Voigt (Iowa State

College, Ames). Prog. Nuclear Energy 1, 322-8(1956).

Plutonium can be satisfactorily removed from molten U by extraction with molten Ag. Other extractants, e.g., Ce, and La, are less promising with respect to Pu. Fission product data are inconclusive although no extractant was effective in removing molybdenum or ruthenium. (auth)

SPECTROSCOPY

2872

ABSORPTION SPECTRA OF SUSPENSIONS OF CAROTENE CRYSTALS. Kazuo Shibata (Univ. of California, Berkeley). Biochim. Biophys. Acta 22, 398-9(1956).

2873

OsO_4: INFARED SPECTRUM OF THE VAPOR AND COMMENTS ON THE OVFF CONSTANTS. N. J. Hawkins and W. W. Sabol (Knolls Atomic Power Lab., Schenectady, N. Y.). J. Chem. Phys. 25, 775-6(1956) Oct.

2874

THE ABSORPTION SPECTRA OF COMPLEX OXALATES. D. P. Graddon (Heriot-Watt College, Edinburgh). J. Inorg. Nuclear Chem. 3, 308-22(1956) Nov.

The ultra-violet absorption spectra of oxalic acid, its simple salts, and numerous complex metallic oxalates have been determined. For many complex oxalates the absorption spectra support structures in which the metal-oxalate bonds are covalent; some further support is provided by observations in the infra-red. A shift in wavelength of absorption of the co-ordinated oxalate group is related to the strength of the electric field in the neighborhood of the co-ordinating metal cation. (auth)

SYNTHESES

2875 NBS-4616

National Bureau of Standards, Washington, D. C.

SYNTHESIS OF β-GENTIOBIOSE-1-C^{14}. Robert Schaffer and Horace S. Isbell. Apr. 9, 1956. 10p.

2876 NP-6172

Pennsylvania State Univ., University Park. Coll. of Chemistry and Physics.

COORDINATION POLYMERS. Bimonthly Progress Report No. 11 [for] September 1, 1956 to October 31, 1956. Dept. of Chemistry. W. C. Fernelius, M. Shamma, N. R. Garofano, D. E. Goldberg, D. F. Martin, and F. D. Thomas, II. 19p. Contract AF33(616)-2742.

2-(p-Methoxyphenyl)-1,1,3,3-tetraacetylpropane, $(CH_3CO)_2CHCH$-(p-$C_6H_4OCH_3$)$CH(COCH_3)_2$, and 1,1,5,5-tetraacetylpentane have been obtained in a pure state. 1,1,4,4-Tetraacetylbutane has been prepared, but has not yet been obtained in the desired state of purity. The Ti content of commercial methyl titanate is about 1.7 times greater than that calculated for pure methyl titanate. The utility of the volumetric method of determining alkoxide content of a coordinated titanium compound is disappointing. Non-volatile viscous products have been obtained by the interaction of the following; n-butyl titanate, sec-butyl titanate, 2-ethyl-n-butyl titanate, and 2-ethyl-n-hexyl titanate on acetylacetone; however, the analysis results indicate that further purification is necessary. Efforts to prepare a characterizable, dibasic, tetracovalent ligand involving phosphorus have failed. Polymeric materials have been obtained from the reaction product of phosphorus pentasulfide with mixed mono and dialcohols by treatment with Ni^{2+} and Co^{3+}. 4,4'-Bis(4-methoxyphenol-2-diazo)-3,3'-dimethoxybiphenyl : 4,4'-bis-(4-methoxyphenol-2-diazo)biphenyl : and 4,4'-bis[4-(1,1,3,3-tetramethylbutyl)phenol-2-diazo]biphenyl have been prepared. Preparation and purification of the copper derivatives of the bis-(o-hydroxazo) dyes have been unsuccessful. (For preceding period see NP-6113.) (auth)

TRACER APPLICATIONS

2877 AEC-tr-2683

A KINETIC METHOD OF USING LABELLED ATOMS TO INVESTIGATE COMPLEX CHEMICAL AND BIOCHEMICAL PROCESSES. 6. RATES OF FORMATION AND CONSUMPTION OF ACETALDEHYDE, CO AND CO_2 IN THE OXIDATION OF PROPYLENE. M. B. Neyman, V. Ya. Efremov, N. K. Serdyuk, and A. F. Lukovnikov. Translated by M. C. Wheeler from Izvest. Akad. Nauk S.S.S.R. Otdel. Khim. Nauk 4, 408-14(1956). 9p.

TRANSURANIC ELEMENTS AND COMPOUNDS

Refer to abstract 2825 and 2831.

URANIUM AND URANIUM COMPOUNDS

2878 CF-56-11-135

Oak Ridge National Lab., Tenn.

CERTAIN PHYSICAL PROPERTIES OF AQUEOUS HOMOGENEOUS REACTOR MATERIALS. M. Tobias. Nov. 23, 1956. 51p. Contract [W-7405-eng-26]. $9.30(ph OTS); $3.60(mf OTS).

Densities of H_2O, D_2O, UO_2SO_4 solutions, $UO_2SO_4-Li_2SO_4$ solutions, uranium oxide and thorium oxide slurries are given as functions of temperature and concentration. Viscosities, vapor pressures, and other properties of various materials are given where available. (T.R.H.)

2879

URANIUM FROM GOLD WASTES. William Q. Hull and Ewen T. Pinkey (Anglo American Corp. of South Africa Ltd., Johannesburg, S. A.). Ind. Eng. Chem. 49, No. 1, 1-10(1957) Jan.

2880

HIGH-TEMPERATURE THERMODYNAMIC PROPERTIES OF URANIUM DIOXIDE. Raymond J. Ackermann, Paul W. Gilles, and R. J. Thorn (Argonne National Lab., Lemont, Ill. and Univ. of Kansas, Lawrence). J. Chem. Phys. 25, 1089-97(1956) Dec.

The results of these effusion measurements reveal that the heat and entropy of sublimation of UO_2 are 137.1 ± 1.7 kcal/mol and 36.4 ± 0.9 eu at 1800°K and 159.6 kcal/mol and 49.4 eu at 298°K. Other values and relationships are calculated and derived. (T.R.H.)

2881

ON THE INFINITE MULTIPLICATION CONSTANT AND THE AGE OF THE URANIUM MINERALS. P. K. Kuroda (Univ. of Arkansas, Fayetteville). J. Chem. Phys. 25, 1295-6(1956) Dec.

2882

THERMAL EXPANSION COEFFICIENTS FOR URANIUM BORIDE AND β-URANIUM SILICIDE. Gunvor Berkman (Inst. of Chemistry, Univ. of Upsala) and Roland Kiessling (AB Atomenergi, Stockholm). Nature 178, 1341(1956) Dec. 15.

Thermal expansion coefficients for UB_2 and beta-USi_2 have been determined by x-ray methods with a high-temperature camera. The mean values for the expansion coefficients between room temperature and 205°C for different directions in the lattice are summarized. (W.L.H.)

2883
SUR LA STRUCTURE DE L'URANIUM METALLIQUE. J. Friedel (Centre de Recherches Metallurgiques de l'École des Mines, de Paris). Phys. and Chem. of Solids 1, 175-87(1956) Nov.

Various properties of U in its α, β, and γ phases indicate that it is a transitional metal, with probably about one electron per atom in a narrow and almost empty energy band, the form of which is studied. The strongly covalent character of the interatomic bindings, especially in the α phase, suggests that 3 to 4 electrons per atom fill completely a second narrow band. There should remain about one electron per atom in a broad conductibility band with a normal mass. The full binding band should be at about 0.3 ev below the Fermi level in the a phase; excitation of electrons from this band could explain high temperature anomalies observed in the a phase. The approximations made are discussed. Some conclusions could be checked by measurements of the Hall constant and the optical absorption. (auth)

Refer also to abstract 2829.

ENGINEERING

2884 AECD-3737
Carbide and Carbon Chemicals Co. K-25 Plant, Oak Ridge, Tenn.
TESTS TO DETERMINE SAFE OPERATING CONDITIONS FOR USE OF WATER SPRAY PROTECTION FOR ENERGIZED ELECTRICAL TRANSFORMERS. W. L. Richardson. Jan. 7, 1955. Changed from OFFICIAL USE ONLY May 22, 1956. 22p. Contract [W-7405-eng-26]. (KS-461).

2885 AERE-T/R-622
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
THEORY OF THE SPIRAL GROOVED THRUST BEARING WITH LIQUID OR GAS LUBRICANT. R. T. P. Whipple. Mar. 6, 1951. 23p.

The thrust for the spiral groove thrust bearing was calculated and the optimum shape of the grooves at low speeds was determined. (F.S.)

2886 K-1312
Oak Ridge Gaseous Diffusion Plant, Tenn.
PARALLEL CASCADE SECTIONS. J. Shacter — W. N. Johnson, ed. Dec. 28, 1956. 32p. Contract W-7405-eng-26. $6.30(ph OTS); $3.00(mf OTS).

The relationships developed for binary separation in a simple cascade are extended to apply to the case of parallel sections within a cascade. Criteria for deciding when to operate sections in parallel and how many sections to operate in parallel are given. Effects of net circular flows, unequal numbers of stages, unequal flow rates, and unequal separation factors are described. Losses are given for cases near the feed point in terms of reduced gradients (or number of stages). (auth)

HEAT TRANSFER AND FLUID FLOW

2887 AERE-ED/M-26
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
EFFECT OF ECCENTRICITY ON TEMPERATURE DISTRIBUTION IN LIQUID METAL DOUBLE-ANNULUS HEAT-EXCHANGER. J. Woodrow. Aug. 31, 1955. Decl. with amendments Feb. 20, 1956. 9p.

The results of a mathematical investigation into the effect of an eccentric middle tube on the temperature distribution in the double-annulus type of counter-flow heat exchanger are presented. (auth)

2888 CF-56-11-142
Oak Ridge National Lab., Tenn.
PLUGGING OF THE HIGH PRESSURE HEAT EXCHANGER IN THE SLURRY BLANKET MOCK-UP. I. M. Miller. Nov. 15, 1956. 13p. Contract [W-7405-eng-26]. $3.30 (ph OTS); $2.40(mf OTS).

2889 NP-6160
Mine Safety Appliances Co., Callery, Penna.
INDUSTRIAL SURVEY ON ORGANIC HEAT TRANSFER MEDIA. Technical Report 52. J. W. Mausteller and K. R. Barker. Nov. 30, 1956. 29p. Contract NObs-65426.

Organic heat transfer media are being considered as moderator-coolants in nuclear reactors. A survey has been made of industrial experience in handling organic heat transfer media, such as Dowtherm, in the hope that maximum advantage could be taken of present knowledge. Questionnaire returns have been most encouraging in showing that systems operated at high temperature (700 to 800°F) conditions are reliable and that many shell and tube organic-water heat exchangers or steam generators are in constant use. (auth)

2890 R52GL-300
General Electric Co. General Engineering Lab., Schenectady, N. Y.
GRAPHICAL PRESENTATION OF COMPRESSIBLE FLOW FUNCTIONS. I. H. Edelfelt. Dec. 9, 1952. 117p.

This report presents, in graphical form, the solution to the more commonly used compressible flow functions describing isentropic flow, irreversible flow, normal shocks, two-dimensional shocks, and three-dimensional shocks. (auth)

MATERIALS TESTING

2891 HW-41727
Hanford Atomic Products Operation, Richland, Wash.
EVALUATION OF GOLD AND GOLD ALLOY BEARINGS IN PROCESS PUMPS. J. Dunn. Feb. 13, 1956. 10p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

The test results for Au, Au–Cu–Ag, and Au–Cu bearings against various journals in deepwell turbine pumps and chempumps are tabulated and discussed. (T.R.H.)

2892 KAPL-M-GDC-6
Knolls Atomic Power Lab., Schenectady, N. Y.
EXPERIMENTAL WORK ON CLASS C INSULATION FOR LIQUID METAL PUMPS. G. D. Collins. Aug. 15, 1952. Decl. June 18, 1956. 7p. Contract W-31-109-Eng-52. $1.80(ph OTS); $1.80(mf OTS).

The development of a program to learn the use of class C insulating materials in liquid metal pumps is presented. The specification for the insulation assembly is given. The fabrication of insulated coil assemblies using tapes, binders, and enamels and the insulation of conductors placed in slots using enamels, ceramic spacers, and fillers, and fugitive or permanent binders were investigated. (J.E.D.)

2893
BASIC PRINCIPLES AND TECHNIQUES OF EDDY CURRENT TESTING. H. L. Libby (General Electric Co., Richland, Wash.). Nondestructive Testing 14, 12-18, 27 (1956) Nov.-Dec.

The basic principles and techniques of eddy current testing have been presented by the discussion of specific experimental testing results. An attempt has been made

to explain the test results in terms of basic eddy current theory, but no detailed analytical treatment is given. It is realized that this presentation is not complete and may suggest to the reader many unanswered questions. In such event it is hoped that sufficient background information has been presented to encourage the reader to look further into this expanding field. (auth)

PUMPS

2894 CF-56-10-114
Oak Ridge National Lab., Tenn.
DIAPHRAGM FEED PUMP DEVELOPMENT PROGRAM PROGRESS REPORT. R. Blumberg, C. H. Gabbard, and E. C. Hise. Oct. 29, 1956. 37p. Contract [W-7405-eng-26]. $6.30(ph OTS); $3.00(mf OTS).

In the development of a diaphragm feed pump which will last the lifetime of a commercially acceptable power reactor, the following conclusions are drawn: a girth welded check valve body is satisfactory, 100 mesh screen should be used in the pump head, the diaphragm should be 0.031 in. thick and operated in the middle of the chamber, and low O_2 pressure should be avoided. (T.R.H.)

2895 TID-5068
California Research Corp., Richmond, Calif.
DESIGN, CONSTRUCTION, AND OPERATION OF MOLTEN BISMUTH TEST PUMP. J. E. Walkey. Oct. 9, 1951. Decl. Dec. 7, 1956. 47p. (SPL-51:28). $9.30(ph OTS); $3.60(mf OTS).

MINERALOGY, METALLURGY, AND CERAMICS

CERAMICS AND REFRACTORIES

2896 AERE-C/M-224
Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.
PRELIMINARY INVESTIGATIONS IN THORIA SLURRIES. J. K. Dawson, K. Alcock, and A. R. Chilton. Oct. 24, 1954. 11p. (RCTC/P-30).

The preparations of ThO_2 and ThO_2 slurries and their properties are discussed. (T.R.H.)

2897
ON LIQUID SINTERING OF ALKALINE EARTH OXIDES OF DOLOMITE. G. V. Kukolev, and I. A. Kryzhanovskaya. (All-Union Research Inst. of Refractory Materials). Zhur. Priklad. Khim. 29, 1502-11(1956) Oct. (In Russian)

Effects of fusion on the sintering properties of dolomite basic oxides were investigated. Constitution diagrams and tabulations were studied of various systems containing CaO and MgO at calcination temperatures up to 1600°. It was found that only the admixtures of oxides whose interacting energies between cations and oxygen were within the range of $0.4e^2$ to $1.0e^2$ produced favorable effects on the sintering of mixtures rich in CaO and in mixtures of Ca and Mg oxides. (R.V.J.)

Refer also to abstract 2851.

CORROSION

2898 ANL-5587
Argonne National Lab., Lemont, Ill.
CORROSION AND OTHER ASPECTS RELATIVE TO THE USE OF DIPHENYL AS A COOLANT-MODERATOR. Gustave C. Milak. Nov. 1956. 43p. Contract W-31-109-eng-38. $0.30(OTS).

In over 4500 hr of testing in static diphenyl at 500F, 680F, and 750F, U and high-U alloys showed considerably lower corrosion rates and no tendency toward catastrophic failure by comparison with their counterparts in high-temperature H_2O. Corrosion of structural and cladding materials was, in general, equivalent to that of stainless steel in H_2O. Diphenyl showed much better lubricating qualities than H_2O. Burnout heat fluxes of 500,000 Btu/(hr)(sq ft) were attained in stagnant, subcooled diphenyl at atmospheric pressure. Based on physical properties and solubility tests, boric acid esters showed promise as shutdown poisons for diphenyl reactors. Samples representative of two methods of coating uranium (as contrasted to cladding) were investigated. The technology does not appear sufficiently advanced for these coatings to fulfill the stringent requirements of a sole barrier between uranium and the diphenyl coolant. (auth)

2899 CRDC-646
Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.
DEFECT TEST ON U-2 w/o Zr ALLOY IN THE X-2 LOOP. Test No. 1. R. F. S. Robertson and F. H. Krenz. Apr. 1956. 38p. (AECL-366).

A defected 2 wt. % Zr–U alloy specimen, clad by coextrusion in Zircaloy-2 and bonded by a diffusion heat treatment, was irradiated in the X-2 loop with the following objectives: to find whether the corroding core metal released fission product activity into the water stream in sufficient quantities to be detected by suitable monitor downstream, and to find whether such activity could be identified in time to allow shutdown of the reactor and removal of the fuel specimen before corrosion led to extensive sheath failure. A delayed neutron monitor, a γ monitor, and an I_2 monitor were installed in different parts of the loop for this test. It became apparent in the course of the experiment that the 0.01 in. defect hole had somehow become plugged, for the specimen survived ~30 hrs at 540 to 550°F without an indication of abnormally high fission product activity in the loop water. Results were finally obtained subsequent to a drastic thermal and power cycle which appeared to dislodge the plugging material. An indication of rising activity was noticed on the I monitor about 7 hrs after the thermal cycle (5 hrs above 500°F). This signal increased in magnitude for about an hour during which the loop was operated at 540°F, then suddenly increased abruptly to a series of peaks. These were also shown by the γ monitor in the same circuit, though before the peaks this monitor had registered only background activity. Following the peak signals the loop was rapidly cooled. Upon disassembly and subsequent examination of the specimen, which was accomplished without difficulty, it was found that the sheath had ruptured in the immediate vicinity of the hole and that 200 to 400 mg of the core metal had been corroded away in a shallow pit directly under the hole. Measurements of the contents of Kr^{88}, I^{133}, Xe^{133}, I^{131} and Xe^{135} in the loop water prior to and during the corrosion of the core metal gave results indicating that, prior to the signal on the monitors, negligible amounts of fission products were released to the coolant stream. Analyses performed after the signal indicated that, during the rapid corrosion of the fuel, volatile fission products were released completely to the coolant. (auth)

2900 DP-170
Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Augusta, Ga.
CORROSION OF STEEL PIPE BY SAVANNAH RIVER

WATER. Fred Welty. Aug. 1956. 15p. Contract AT (07-2)-1. $0.20(OTS).

Test sections of carbon steel pipe were pitted to a maximum depth of 0.06 inch during 30 months of exposure to flow of raw river water. The rate of pitting penetration of new pipe decreased with time during the first year of exposure and thereafter levelled off at approximately 0.01 inch per year. (auth)

2901 WADC-TR-55-470(Pt. 2)

Michigan. Univ., Ann Arbor. Engineering Research Inst. AN INVESTIGATION OF INTERGRANULAR OXIDATION IN STAINLESS STEELS AND HIGH-NICKEL ALLOYS. Period covered: April 30, 1955 to June 30, 1956. Clarence A. Siebert, Maurice J. Sinnott, Lynn H. DeSmyter, and Harry M. Ferrari. July 1956. 52p. Project title: ANPP DEVELOPMENT SUPPORT PROJECT. Task title: MATERIALS FOR G. E. SUB-SYSTEMS. Contract AF33 (616)-353. (AD-110440).

Specimens from Chromel ASM, Hastelloy B, and commercial and vacuum-melted type 310 stainless steel alloys were oxidized for 100-hr periods in the stressed condition. Intergranular oxidation measurements were obtained microscopically. In general, the intergranular penetrations increased rapidly with stress after a certain minimined for each alloy at various temperatures. The weight gained during oxidation was determined. It was found that most of the alloys tested followed the parabolic oxidation law. (auth)

2902 AEC-tr-2705

THE PROTAL PROCESS. Leon Ades. Translated by K. S. Bevis from Rev. aluminium 28, 230-2(1951). 5p.

A chemical process for protection of Al and Al alloys against corrosion is described. The clean metal is immersed in a bath containing F_2, Cr, and Ti. Couples of light metals with Ni, Cr, and Cd may be Protalized. (T.R.H.)

2903

CORROSION OF STRUCTURAL MATERIALS IN HIGH PURITY WATER. A. H. Roebuck (Continental Oil Co., Ponca City, Okla.). and C. R. Breden and S. Greenberg (Argonne National Lab., Chicago, Ill.). Corrosion 13, 87-90(1957) Jan.

Tests were run to determine the corrosion resistance of a number of metals in high temperature, high-purity water. Materials showing the highest corrosion resistance included austenitic stainless steels, precipitation hardening stainless steels, cobalt alloys, Pt, Ti, Zr, and Hf. Materials of intermediate resistance included Al, Cr, 70 to 30 Cu–Ni, ferritic and martensitic stainless steels, Ni and Ni alloys. Test materials showing lowest resistance were Cu, bronzes, Mg, plain carbon steels and Ag. Of the factors affecting corrosion, the system temperature, the system gas concentration (particularly with respect to dissolved oxygen) and the metal surface are of importance. Techniques which can be used to prepare metal surfaces are discussed and compared. Data are given for machined and vapor blasted specimens exposed for 500-1500 hour periods to moving water of various oxygen concentrations. (auth)

2904

CORROSION ENGINEERING PROBLEMS IN HIGH PURITY WATER. D. J. DePaul (Westinghouse Electric Corp., Large, Penna.). Corrosion 13, 91-6(1957) Jan.

Described are some of the important corrosion problems encountered in systems exposed to recirculating high purity water with respect to the particular engineering application of materials. Special attention is given to crevice, galvanic intergranular and stress corrosion as a function of the various materials studied. Materials considered include 18 to 8 type stainless steels, Co base alloys, hard Cr plate, Cu base alloys, Ni base alloys, and straight chromium stainless steels. Data are given to show the effect of oxygen and clearance on crevice corrosion at 500 F. Also shown is the effect of temperature on crevice corrosion in oxygen-bearing water. (auth)

2905

THE IMPORTANCE OF HIGH PURITY WATER DATA TO INDUSTRIAL APPLICATIONS. W. Z. Friend (The International Nickel Co., New York). Corrosion 13, 97-101 (1957) Jan.

The most common industrial use of very high purity water is for boiler feed water in modern high temperature high pressure steam plants. It has industrial uses also in chemical research laboratories, pharmaceutical production, manufacture of color film, manufacture of high resistivity dielectric papers, electroplating, processing synthetic textile fibers, catalyst production and in the application of phosphor coatings in television tubes. Experience has shown that high purity water is more aggressive than most less pure waters in corrosion of iron and steel, particularly if dissolved oxygen is present. A review of available information on plant experience indicates that corrosion resistant metals such as stainless steels, Ni alloys or Al are generally required to handle high purity water. At moderate temperatures non-metallic materials such as rubber and vinyl polymers are often used to avoid metallic contamination. (auth)

GEOLOGY AND MINERALOGY

2906

DETERMINATION OF THE ABSOLUTE AGE OF KALONGWE AND LUISHYA (KATANGA-CONGO BELGIAN) PITCHBLENDES. D. Ledent (Laboratorie de Mineralogie de l'Université de Bruxelles). Bull. de la Soc. belge de Paleontol., et d'Hydrol., 65, 230-3(1956) May 15. (In French)

2907

USE OF LIQUID EMULSIONS IN THE STUDY OF THE RADIOACTIVITY OF ROCKS. E. Picciotto (Laboratorie de Physique Nucléaire, Université Libre de Bruxelles.). Bull. de la Soc. belge de Geol., de Paleontol., et d' Hydrol., 65, 257-60(1956). (In French)

2908

URANIUM DEPOSITS OF THE NORTHERN PART OF THE BOULDER BATHOLITH, MONTANA. George E. Becraft. Econ. Geol. 51, 362-74(1956) June-July.

Uranium minerals and radioactivity anomalies occur in many silver-lead veins and chalcedony veins and vein zones in the Boulder batholith of southwestern Montana. Pitchblende has been identified in a few silver-lead veins. These silver-lead veins occupy shear zones along which there is no evidence of large-scale lateral displacement. The wall rock adjacent to the veins is intensely silicified and sericitized quartz monzonite and granodiorite. The veins have yielded substantial quantities of lead, silver, zinc, and gold. The silver-lead veins consist principally of galena, sphalerite, tetrahedrite, chalcopyrite, and pyrite in a gangue of light- to dark-gray quartz, altered rock, gouge, and subordinate chalcedony and carbonate minerals. No anomalous radioactivity nor uranium minerals have been found in similar veins in prebatholithic rocks of the area. Chalcedony veins and vein zones, some of which are uraniferous, are distinctly different from the silver-lead veins and, with a single exception are known only in the batholith. The chalcedony vein zones consist of one or more discontinuous stringers or veins of chalcedony and microcrystalline quartz in silicified and sericitized quartz monzonite and granodiorite, and in less strongly altered alaskite.

Only small amounts of silver ore have been produced from these chalcedony veins and vein zones. All of the veins are early Tertiary in age, but the silver-lead veins probably are are older than the chalcedony veins. Uranium is closely associated with chalcedony and microcrystalline quartz in both types of veins. This association suggests that all of the uranium in the area is of the same age. If so, some of the silver-lead veins must have been reopened during the period of chalcedony vein formation. (auth)

2909

STRATIGRAPHY OF PARTS OF DE SOTO AND HARDEE COUNTIES FLORIDA. M. H. Bergendahl. U. S. Geol. Survey Bull. 1030-B, 1956. 25p and 4 illus.

The late Cenozoic stratigraphy of part of central Florida immediately south of the land-pebble phosphate district was studied in detail to determine the southern limit of the economically important Bone Valley formation and its relations with marine rocks of late Miocene and Pliocene age in south-central Florida. In addition, a reconnaissance-type appraisal of the phosphate and uranium resources of this area was desired. The upper Tertiary and Quaternary rocks were mapped, and the economic geology was studied in a general manner. The Hawthorn formation, of early and middle Miocene age, is the oldest rock exposed. Undifferentiated phosphatic sand and clay of late Miocene to Pliocene age may be composed of: (1) the Bone Valley formation, (2) a combination of Bone Valley formation and residuum of weathered Hawthorn formation, or (3) residuum of the Hawthorn alone. The Bone Valley formation and residuum of the Hawthorn formation appear to be almost identical in cuttings from auger drilling in this area. It was neither feasible nor practical to map these two units separately. The undifferentiated phosphatic sand and clay interfingers with a marine sand of late Miocene age. The Caloosahatchee marl, of Pliocene age, is present in the southeast corner of the area investigated. It is apparent that the undifferentiated phosphatic sand and clay was undergoing subaerial erosion and reworking during deposition of the Caloosahatchee marl. Stratified sand and clayey sand containing scattered thin lenses of fresh-water limestone and marl of Pleistocene age are believed by the writer to be either flood-plain deposits or subaerial top-set beds of a delta made by the Pleistocene Peace River. Stream deposits of Recent age are present locally along the Peace River and its tributaries. Bars and shoals in the Peace River south of Brownville, De Soto County, contain appreciable tonnages of low-grade "river-pebble" phosphate. The phosphate and uranium content of the undifferentiated phosphatic sand and clay in Hardee County is too low to be of economic significance. (auth)

2910

STRATIGRAPHY OF THE MORRISON FORMATION IN PART OF NORTHWESTERN NEW MEXICO. V. L. Freeman and L. S. Hilpert. U. S. Geol. Survey Bull. 1030-J, 1956. 28p.

In the summer of 1954 while investigating the uranium resources of northwestern New Mexico, the writers noticed that the stratigraphic nomenclature of the Morrison formation in use in the Laguna area was not consistent with that in use elsewhere in the region. A review of the literature led to the agreement that the nomenclature currently in use elsewhere in the area, such as near Grants, is satisfactory. This usage divides the Morrison formation into three members; in ascending order they are the Recapture, the Westwater Canyon, and the Brush Basin members. These members may be recognized and have been correlated throughout northwestern New Mexico. In the Laguna area the Recapture, Westwater Canyon, and most of the Brushy Basin members, as correlated by the writers, are present in the stratigraphic interval that has previously been considered as Recapture. The sandstone previously considered as Westwater Canyon is in our opinion at the top of the Brushy Basin. This sandstone is of economic importance and is informally called the Jackpile ore-bearing bed. (auth)

2911

RARE-EARTH-BEARING APATITE AT MINEVILLE, ESSEX COUNTY, NEW YORK. F. A. McKeown and Harry Klemic. U. S. Geol. Survey Bull. 1046-B, 1956. 19p.

Dumps and tailings piles of six mines and underground workings of three mines in the Mineville district, Essex County, N. Y., were tested for radioactivity and sampled to determine the extent of the occurrence of rare-earth-bearing apatite. One of the mines currently operated by the Republic Steel Corporation is in the "lower" Old Bed magnetite ore body; six levels were tested and sampled. Radioactive elements and rare earths occur in apatite in this bed everywhere it was tested. Samples and radioactivity tests in part of the abandoned Smith mine indicate that it may contain the same type of apatite-rich magnetite ore as the Old Bed. Laboratory studies indicate that most of the rare earths, thorium, and uranium in Old Bed ore are in fluorapatite. Monazite, bastnaesite, and hematite fill fractures in and form rims around some of the apatite, but are so fine grained and intergrown that separation of them from apatite and from one another has not yet been achieved. Fourteen samples of apatite separated from magnetite ore from the Mineville district average 0.032% U, 0.15% Th, and 11.14% rare earth oxides. Scatter diagrams of sample data show that there is a direct, but poor, correlation of P, U, Th, and rare earths with radioactivity. Two types of magnetite ore occur in the Mineville district, one high in P and one low. None of the low-phosphorus ores are radioactive. Four of the six high-phosphorus ores tested are radioactive. Two of these, the lower Old Bed and Upper Joker, are essentially the same ore body. Ore from the Smith mine is very similar to Old Bed ore and is radioactive. Some apatite-rich magnetite ore from the Cheever mine is radioactive, but it is unlike Old Bed ore. No structural or lithologic controls for the abundance or composition of the apatite have been recognized. (auth)

METALS AND METALLURGY

2912 AD-95136

Sintercast Corp. of America, Yonkers, N. Y.

RESEARCH ON HEAT RESISTANT ALLOYS STRENGTHENED AT ELEVATED TEMPERATURES BY INCORPORATION OF FINE PARTICULATE SUBSTANCES. Interim Report No. 2 [for] January 17, 1956 through March 16, 1956. Eric Gregory and Martin Epner. Apr. 11, 1956. 14p. Contract NOas-56-227-C.

In the program for the development of reinforced metal products based on heat-resistant alloys, an investigation into the manufacture or availability of ultrafine powders has continued and meanwhile four extrusion billets, two of which contain fine titanium carbide dispersions, have been produced with the materials available at present. From these it is hoped to obtain information on the extrusion conditions and possibly stress rupture data which will provide a basis for comparison of the effects of the ultrafine dispersions to be added later. (auth)

2913 BMI-1151

Battelle Memorial Inst., Columbus, Ohio.

FABRICATION OF MOLYBDENUM SHEET. John R. Van Orsdel and Roland B. Fischer. Dec. 5, 1956. 10p. Contract W-7405-eng-92. $0.30(OTS).

The objective of the research described was to try to

find a method of fabricating commercial Mo into $^1/_{16}$-in.-thick sheet which would have good room-temperature ductility. An additional condition which was desired of the final sheet was that the grain structure should not be fibered. The data strongly indicate that careful rolling and heat-treating procedures will produce sheet capable of 90-deg bends, transverse to the rolling direction, at room temperature. Furthermore, the scattering of results of the bend test was found to be significantly influenced by the rolling procedure. The variables which were found to be operative in determining the ductility of the final material are initial rolling temperature, final rolling temperature, rate of ingot reduction, ingot thickness at the beginning of the finish-rolling step, and heat treatment time and temperature. It was also found that the ductility of the final sheet was not destroyed by heating the sheet for 115 hr at 1800°F. However, higher long-time holding temperatures did destroy the ductility by what is believed to be complete recrystallization. No evidence of fibering was revealed in the microstructure of the ductile material. (auth)

2914 BRB-28

Bridgeport Brass Co., Conn.

CHEMICAL BASE COATINGS FOR ZIRCONIUM AND ZIRCALOY. E. J. Hennessey and A. W. Grella. Mar. 15, 1956. 26p. Contract AT(30-1)-1405.

A successful chemical bath was developed for the surface treatment of Zr. This bath produces a coating which is easily applied, tightly adherent, has a low coefficient of friction on tool materials and is readily removed leaving a smooth surface. By means of extensive laboratory and mill trials information on the optimum operating conditions of the bath were obtained. The use of this phosphate coating as a lubricant undercoat has proven very successful when used in combination with the proper lubricant during tube drawing. This undercoating was compared qualitatively with the proprietary coatings produced by three companies in this field. It has proved to be at least as good as the best of these and thirteen times less expensive to prepare. Accurate data on the working life of the bath have been prepared. No satisfactory analytical control methods for the determination of all the constituents of a depleted bath have yet been developed. (auth)

2915 ISC-204

Ames Lab., Ames, Iowa.

CONSTITUTION DIAGRAM OF THE ANTIMONY–ZIRCONIUM ALLOY SYSTEM. R. F. Russi, Jr. and H. A. Wilhelm. Aug. 1951. Decl. June 5, 1956. 49p. Contract W-7405-eng-82. (deleted version: AECD-3610).

Antimony–zirconium alloys were prepared by diluting a master alloy of 23.6 wt.% Sb with Mg-free sponge Zr. The master alloy was made by diffusing analytical grade Sb into sponge Zr in a sealed stainless steel container, at a temperature of about 825°C. These alloys were studied by microscopic examination of slow-cooled and quenched specimens. Thermal analysis and fusion temperatures as well as x-ray, corrosion, and hardness data were obtained. The addition of Sb to Zr was found to bring about a peritectoid transformation, raising the solid α-to-β transformation for Bureau of Mines sponge Zr from about 925°C to approximately 980°C. The beta Zr solid solution extends to 14 wt.% Sb at the eutectic temperature of 1430°C and this drops off to about 2% at the peritectoid temperature. Antimony is soluble to about 2.5 wt.% Sb in alpha Zr from room temperature to the solid transformation. A eutectic was located at about 22% Sb. A compound which is reactive with water and atmospheric moisture was identified as Zr_2Sb. Antimony was found to harden Zr in all cases, making increasingly brittle alloys as the compound was approached. The resistance to corrosion by 315°C water was increased by certain additions of Sb. (auth)

2916 NP-6161

Utah. Univ., Salt Lake City. Inst. for the Study of Rate Processes.

THE ENGINEERING APPLICATION OF THE ABSOLUTE RATE THEORY TO THE CREEP OF SOME ALUMINUM ALLOYS. Mervin B. Hogan. June 30, 1956. 61p. Technical Report No. LVII. Project No. NR-032-168. Contract N7-onr-45101.

A number of creep data pertaining to several Al alloys at different temperatures have been analyzed on the basis of the absolute rate theory. The agreement between the results and the theory is found to be good; leading to the conclusion that the absolute rate theory is a very satisfactory engineering interpretation of the creep properties of those Al alloys analyzed. (auth)

2917 NP-6163

Clevite Research Center, Cleveland.

RESEARCH ON THE LUBRICATION OF TITANIUM. Quarterly Progress Report No. 3 [for] August 15, 1956 to November 14, 1956. Richard Lee. Nov. 13, 1956. 26p. Project No. 50167 G. Contract AF33(616)-3350.

Titanium is highly susceptible to galling and seizure. Past efforts to reduce this tendency have uncovered special lubricants and surface treatments. This investigation seeks to elucidate the role of the oxide film on Ti, to obtain some information about the frictional properties of modified Ti coatings and to make a direct comparison of the wear resistance of the best surface treatments in the presence of various lubricants using equipment generally acceptable for wear tests under conditions of boundary lubrication. The studies on contract resistance carried out on the stick-slip machine are reported in detail. It was concluded that the oxide layer on untreated Ti is thin and ineffective. Studies on the stick-slip machine at 350°F gave indications of good wear resistance of nitrided coatings and showed a large reduction in friction for fluorided coatings. Halocarbon 11 to 14 was most effective at 300°F, reducing the coefficient of friction of untreated Ti vs. itself. Studies on the Shell Four-Ball Wear Tester indicated much lower wear for the rubbing surface combination of bronze on Ti than for either steel or Ti on Ti. Halocarbons were the only lubricants tested which substantially reduced friction and wear of Ti rubbing on Ti. (auth)

2918 NP-6170

California. Univ., Berkeley. Minerals Research Lab.

DEFORMATION AND FRACTURE OF ALPHA SOLID SOLUTIONS OF LITHIUM IN MAGNESIUM. Technical Report No. 4. F. E. Hauser, P. R. Landon, and J. E. Dorn. Sept. 15, 1956. 41p. Contract DA-04-200-ORD-171.

Whereas coarse polycrystalline aggregates of Mg are brittle at 78°K, alpha solid solutions of Li in Mg are ductile. The improved ductility of the Li alloys of Mg is associated with the introduction of prismatic $(10\bar{1}0)\langle\bar{2}110\rangle$ slip in addition to basal $(0001)\langle\bar{2}110\rangle$ slip. Evidently in the absence of prismatic slip, dislocation arrays pile up against the grain boundaries causing high localized tensile stresses that exceed the cohesive strength of the metal. But the introduction of prismatic slip permits deformation of the adjacent grains and thereby reduces the tendency toward formation of piled-up arrays of dislocations. The incidence of prismatic slip is unique for Mg–Li alloys since Li is the only effective alloying element for reducing the axial ratio of Mg. (auth)

2919 NP-6181

Chicago. Univ. and Argonne National Lab., Lemont, Ill.

THERMODYNAMICS OF REFRACTORY MATERIALS AS

DETERMINED WITH A MASS SPECTROMETER. TECHNICAL REPORT NO. 3. MASS SPECTROMETRIC STUDY OF VAPORIZATION OF THE TITANIUM–OXYGEN SYSTEM. TECHNICAL REPORT NO. 4. THERMODYNAMICS OF THE V–O SYSTEM: THE DISSOCIATION ENERGIES OF VO AND VO_2. Period Covered to December 31, 1956. Mark G. Inghram, Joseph Berkowitz, and William A. Chupka. 28p. OOR Project No. 1543. Contract DA-11-022-ORD-1993.

2920 NYO-6330

Pittsburgh. Univ.

APPLICATION OF CHEMICAL THERMODYNAMICS TO THE STUDY OF ALLOY FORMATION. Progress Report for January 1, 1956 to April 1, 1956. W. E. Wallace, R. S. Craig, C. A. Krier, W. Saba, and M. G. Zabetakis. 7p. Contract AT(30-1)-647. $0.15(OTS).

Provisional heat capacity results are available for Zn (12 to 320°K) and Mg (20 to 270°C). Final results for Na_2K (12 to 321°K) are available and are being prepared for publication in the Journal of the American Chemical Society. Assuming the liquid alloys to be formed with ΔS = the entropy of random mixing, the entropy of Na_2K at 0°K is 0.00 e.u./g. atom. Cp for Na_2K rises above the Dulong-Petit limit as its (incongruent) melting point is approached in a fashion rather similar to the rise in Cp for the pure alkali metals near their melting points. (auth)

2921 NYO-7786

Aeroprojects, Inc., West Chester, Penna.

LITERATURE REVIEW OF GRAIN-REFINING EFFECTS OF VIBRATORY TREATMENT OF METALS. Interim Report No. 1. Aug. 1956. 35p. Contract AT(30-1)-1836. $6.30(ph OTS); $3.00(mf OTS).

Systematic review of data concerning application of vibratory energy to molten metals has revealed significant grain-refining effects in a variety of metals. Successful grain-size reduction has been reported for metals and alloys ranging in melting point from 230 to 1500°C. Associated effects such as increased tensile strength, elasticity, ductility, hardness, and decreased brittleness have also been achieved with ultrasonic energy application. The literature indicates reasonably good agreement that intensity of elastic vibratory treatment is the important criterion for successful treatment rather than frequency, and that maximum effects are achieved when ultrasonic treatment is applied during the solidification period. Varying theories of the ultrasonic mechanism are contained in the literature with most investigators agreeing that the vibratory energy increases the number of crystallization nuclei present which enhances multismall grain growth. Equipment and procedures utilized in past ultrasonic grain refinement work were reviewed and each is described listing advantages and disadvantages. These sources of ultrasonic energy included mechanical, electrodynamic, magnetostrictive, piezoelectric, electrostrictive, and electromechanical systems. Coupling of energy to the melt has been accomplished by a number of methods including vibration of the melt crucible, probe contact, and probe immersion in the melt. The requisites for good coupling of vibratory energy to melts are here delineated and various efforts to solve acoustical attenuation problems existing in work with molten metals are outlined and related to cavitation effects. (auth)

2922 NYO-7787

Aeroprojects, Inc., West Chester, Penna.

INVESTIGATION OF GRAIN REFINEMENT IN BERYLLIUM INGOTS RESULTING FROM THE APPLICATION OF ELASTIC VIBRATORY ENERGY DURING COOLING AND SOLIDIFICATION. Progress Report No. 7 Covering Period from July 1, 1956 to August 31, 1956. Sept. 1956. 14p. Contract AT(30-1)-1836. $3.30(ph OTS); $2.40 (mf OTS).

Ultrasonically treated Be test melts were completed. These tests were carried out at higher input powers than previous melts (42 to 63 watt/cm^2 of coupler face area as compared to 7 to 28 w/cm^2). Molybdenum dispersion into the melt was high at ultrasonic treatment times of 1.5 to 3 min., but was minimized when treatment was reduced to 0.5 to 1 min. Four melts from this series utilized one of four additive materials, Ni, Zr, Si, and Ti, in an effort to further enhance Be grain refinement. Good coupler and heat-sink face wetting was accomplished in all tests. Acoustical attenuation studies, carried out with Ta and W rods, indicated that both metals were promising as potential coupler materials. (auth)

2923 TML-60

Battelle Memorial Inst. Titanium Metallurgical Lab., Columbus, Ohio.

PRODUCTION OF TITANIUM SHAPED CASTINGS. R. M. Lang, G. H. Schippereit, and J. G. Kura. Dec. 12, 1956. 46p. Contract AF18(600)-1375.

The types of melting furnaces, mold materials, and alloys that are used in preparing cast Ti parts are described. The best furnace for casting Ti is the skull type that uses a consumable electrode. Skull-melting furnaces equipped with a fixed electrode are also used for casting Ti, but with these furnaces it is difficult to obtain adequate superheat in the melts and there is danger of the electrode contaminating the melts. Induction furnaces are used to make Ti castings, but the castings have low ductility because of C contamination of the melts by the graphite crucible. More recently castings with less than 0.15% C have been made from 5-pound heats induction melted with a high-intensity electrical field that piled the melt in the center of the graphite crucible and thereby attained minimum contact area for carbon pickup. No suitable methods have been found for measuring the temperature of Ti melts before they are poured from the melting furnaces. Consequently, superheat in the melts is measured indirectly by the electrical power consumed after the Ti becomes molten. Molds machined from dense graphite are the best for making sound, smooth, uncontaminated Ti castings. Smaller castings can be made in expendable molds composed of refractory oxides or graphite powder, but the surfaces of the castings are contaminated to a greater depth than castings made in machined graphite molds. Small precision castings of Ti can be made in investment molds but these castings are contaminated also. Titanium and Ti alloys cast to date have strengths approaching those of wrought Ti alloys. The ductility of the cast alloys is somewhat lower. (auth)

2924 WADC-TR-54-616(Pt. III)

Wright Air Development Center. Materials Lab., Wright-Patterson AFB, Ohio.

HYDROGEN CONTAMINATION IN TITANIUM AND TITANIUM ALLOYS. PART III. STRAIN AGING HYDROGEN EMBRITTLEMENT IN ALPHA–BETA TITANIUM ALLOYS. Period covered: July 1954 to October 1955. Harris M. Burte. Oct. 1956. 50p. Project title: METALLIC MATERIAL. Task title: TITANIUM METAL AND ALLOYS. (AD-110439).

Hydrogen contamination in alpha-beta Ti alloys can lead to sudden, brittle fracture during the use of these materials. The strain aging embrittlement which causes such fracture was investigated. Strain aging H embrittlement in alpha-beta Ti alloys has its greatest effect on mechanical properties measured at slow strain rates. It can cause low ductility in room temperature tensile tests and premature brittle fracture in room temperature rupture tests. Frac-

ture due to this process tends to be intergranular. Metallographic examination of many H contaminated alpha-beta alloys shows no evidence for a third phase either before or after fracture. In at least one alloy a third phase was visible after fracture. Both alloy composition and microstructure affect susceptibility to strain aging embrittlement. Increasing test temperature seems to decrease the tendency towards embrittlement, but increases the rate at which embrittlement can occur. A mechanism for strain aging embrittlement is proposed. Other types of embrittlement which may be caused by H are mentioned. (auth)

2925 WADC-TR-55-199(Pt. 1)

Southern Research Inst., Birmingham, Ala.

TENSILE PROPERTIES OF AIRCRAFT STRUCTURAL METALS AT VARIOUS RATES OF LOADING AFTER RAPID HEATING. Period covered: January 1953 to January 1955. Clifford L. Dotson and J. Robert Kattus. Aug. 1955. 174p. Project title: MATERIAL ANALYSIS AND EVALUATION TECHNIQUES. Task title: DESIGN AND EVALUATION DATA FOR STRUCTURAL METALS. Contract AF33(616)-424. (AD-90524).

The effects of the following variables on the tensile properties of seven aircraft-structural sheet metals after they had been heated within 10 sec to temperatures up to 1200°F are described, strain rates from 0.00005 in./in./sec to 1.0 in./in./sec, holding times at test temperature from 10 sec to 30 min. Special testing apparatus for heating and controlling the temperature of the test specimens, loading the test specimens, and recording load-strain curves was developed. The test results showed that the tensile properties of the structurally stable test alloys—Type 321 stainless steel, RC-70A titanium and RC-130A titanium alloy—were not appreciably affected by changes in holding time. Because of the structural changes which occurred, the tensile properties of the precipitation hardening test alloys—Alclad aluminum alloys 2014-T6, 2024-T3, and 7075-T6—and hard rolled AZ-31 magnesium alloy changed as the holding time was varied at certain temperatures. With the exception of the results at one particular test condition, the strength properties of each alloy increased with increasing strain rates. The exception occurred in Alclad 2024-T3 alloy at 450°F, at which temperature a strongly mitigating structural change occurred. Percent elongation in the different test alloys varied inconsistently with increasing strain rates dependent upon the alloy, temperature, and holding time. (auth)

2926 WAPD-RM-156(Del.)

Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.

METALLOGRAPHIC EXAMINATION OF ZIRCALOY 2 SUBJECTED TO VARIOUS ANNEALING TREATMENTS. E. L. Richards. Nov. 26, 1952. 19p. Contract AT-11-1-GEN-14. $4.80(ph OTS); $2.70(mf OTS).

Laboratory annealing of the Sn—Zr alloy should be done in an inert atmosphere with the work held at a temperature of 800°C for at least thirty minutes. Annealing can be accomplished in fifteen minutes at a temperature of 850°C. Annealing of subassemblies should be done in the 750 to 850°C range if softening alone is considered; resistance to corrosion in water at high temperatures is very important in evaluating the alloy. One specimen of each of the heat treatments is being prepared for corrosion testing. Investigation should also be directed to determine the notch impact strength of the structures obtained by the recommended annealing treatment. Final evaluation of the heat treating procedure is contingent upon satisfactory corrosion and impact test results. If machining difficulties arise, it might be possible to vary the microstructure sufficiently by heat treatment to remedy the difficulties encountered. (auth)

2927

SYMPOSIUM ON TITANIUM, INCLUDING PAPERS AND DISCUSSIONS FROM IMD FALL MEETING, AT CLEVELAND, OCT. 1956. J. Metals 9, 161-84(1957) Jan.

The topics discussed are: economics of sponge and mill production; economics of mill and fabrication; analytical developments; practical problems in control of C, O_2, and N_2 impurities in welding and forming, melting and mill processing and shop practice. (T.R.H.)

2928

ENGINEERING ASPECTS OF ION EXCHANGE IN HYDROMETALLURGY. John Dasher (Crucible Steel Co. of America, Pittsburgh); A. M. Gaudin (Massachusetts Inst. of Technology, Cambridge) and R. D. Macdonald (Battelle Memorial Inst., Columbus, Ohio). J. Metals 9, 185-92 (1957) Jan.

The first application of ion exchange to extractive hydrometallurgy is the use of a strong base anion exchange resin for selective recovery of uranium from sulfate leach liquors. The influence of the major variables on column operation is described, plant performance data are summarized, cost factors are enumerated, and the probable application of this operation to metals at least as valuable as copper is predicted. (auth)

2929

PHASE DIAGRAM AND VAPOR PRESSURE IN THE SYSTEMS NaCl—$ZrCl_4$, KCl—$ZrCl_4$, AND NaCl—KCl (1:1 MOLAR)—$ZrCl_4$. L. J. Howell and H. H. Kellogg (Columbia Univ., New York) and R. C. Sommer (American Smelting and Refining Co., South Plainfield, N. J.). J. Metals 9, 193-200(1957) Jan.

Portions of the phase diagrams of the systems NaCl—$ZrCl_4$, KCl—$ZrCl_4$, and NaCl—KCl (1:1 molar)—$ZrCl_4$ have been determined. Particular attention was given to locating compositions which might be useful for electrodeposition of Zr metal. The vapor pressure of $ZrCl_4$ in equilibrium with the condensed phases at various temperatures has been measured by a dew-point technique. Several melt regions which show promise as potential electrolytes for deposition of Zr are described. (auth)

2930

URANIUM—SILICON ALLOYS. A. Kaufmann (Nuclear Metals Inc., Cambridge, Mass.); B. Cullity (Univ. of Notre Dame, South Bend, Ind.); and G. Bitsianes (Univ. of Minnesota, Minneapolis). J. Metals 9, Section 2, 23-7(1957) Jan.

A description of the original work on Si—U systems done in 1944 and a discussion of some of the properties of one of the intermediate phases as ϵ, whose formula is approximately U_3Si are presented. (J.E.D.)

2931

PRELIMINARY INVESTIGATION OF THE Ti—Ce SYSTEM. Jack L. Taylor (California Inst. of Technology, Pasadena). J. Metals 9, Section 2, 94-6(1957) Jan.

The phase diagram of the Ti—Ce system is of the peritectic type. The solubility of cerium in β-titanium near the peritectoid temperature is less than 1%, and the solubility in α-titanium decreases with temperature and is less than 0.19% at 750°C. No intermetallic compounds were found between 0 and 50% Ce. Small Ce additions reduce the grain size of some commercially available Ti alloys. (auth)

2932

STUDIES ON DIFFUSION IN MOLTEN METALS. Kichizo Niwa, Mitsuo Shimoji, Satoshi Kado, Yoshihiko Watanabe, and Toshio Yokokawa (Hokkaido Univ., Sapporo, Japan). J. Metals 9, Section 2, 96-101(1957) Jan.

Diffusion coefficients in molten metals were measured for Sn—Pb, Bi—Pb, Sb—Pb, Cd—Pb, Sn—Bi, and Sb—Sn from 450 to 600°C. Since the observed activation energies of these metals in the liquid state were found to be of the

same order as those for nonmetallic solutions, the diffusing substance may be small particles such as metal ions. For Pb–Sn, Pb–Bi, and Sn–Bi, the concentration dependences of diffusion coefficients were determined at about 500°C. The results show that the relations between diffusion coefficients and atomic fractions obey the thermodynamic formulas of irreversible processes. For a ternary system, Pb–Sn–Bi, the diffusion coefficient of Sn decreases as Bi is added. This effect has been explained in thermodynamic terms. (auth)

2933

URANIUM–BISMUTH SYSTEM. R. J. Teitel (Dow Chemical Co., Midland, Mich.). J. Metals 9, Section 2, 131-6 (1957) Jan.

A phase diagram for the U–Bi system was drawn from data presented and from data of previous investigators. There are three intermetallic compounds: UBi_2, which decomposes peritectically at 1010°C; U_3Bi_4, which decomposes peritectically at approximately 1150°C; and UBi, which decomposes to two liquid phases at a temperature between 1400 and 1450°C. The terminal components react eutectically with the nearest compound. Little solid solubility for either component in the other was indicated. The solubility of U in liquid Bi has been determined up to 900°C. Crystallographic data for the compounds are reported. (auth)

2934

PYROPHORICITY—A TECHNICAL MYSTERY UNDER VIGOROUS ATTACK. Richard B. Smith (Safety and Fire Protection Branch, AEC, Washington, D. C.). Nucleonics 14, No. 12, 28-33(1956) Dec.

The pyrophoricity of Pu, U, Th, Zr, and Hf are discussed. Some of the phenomena observed and some possible mechanisms of the various fires and explosions resulting from storage and handling of the above metals are presented. (W.L.H.)

PHYSICS

2935 NP-6168

Alabama. Univ., Tuscaloosa. Bureau of Engineering Research.

THERMAL SHOCK AND FATIGUE: A LITERATURE SURVEY. Technical Report No. 1. Harry Majors, Jr. June 1956. 50p. Project No. 1230. Contract DA-01-009-ORD-454.

2936 ORNL-2207

Oak Ridge National Lab., Tenn.

SPHERICAL SEGMENT WITH CIRCULAR HOLE AT VERTEX LOADED AXISYMMETRICALLY ALONG THE EDGES. Floyd J. Stanek. Jan. 3, 1957. Appendix A: AXIALLY LOADED CIRCULAR CYLINDER ATTACHED TO SPHERICAL SHELL. 45p. Contract W-7405-eng-26. $0.35(OTS).

The results of a stress analysis of a spherical segment with circular hole at the vertex which is loaded symmetrically with respect to its axis along the edges of the shell are given. Results were obtained and are given for two cases. General Loading, i.e., normal force, radial shearing force, and bending moment applied at each of the two edges of the shell and General Loading at inner edge with outer edge rigidly fixed. The classical, small-deflection theory of thin shells was used. This method involves the evaluation of four hypergeometric series and their derivatives which give the solution to a fourth order differential equation for the shearing force, Q_ϕ. The above problem is then extended by attaching an axially loaded circular cylinder to the inner edge of the shell. The manner in which this was done is shown. Several cases were analyzed, and the results are summarized. The cases differ primarily in their relative geometrical dimensions and outer edge conditions. These differences are summarized. The relative dimensions for Case A1 were selected, so as to coincide, as nearly as it was possible to do so, with a physical model from which the principal stresses were obtained experimentally. A comparison is then made between the theoretical and the experimental results. In general, the two results are in good agreement. (auth)

2937 WADC-TR-55-495(Pt. III)

Illinois Inst. of Tech., Chicago. Armour Research Foundation.

MEASUREMENTS OF THERMAL PROPERTIES. Period covered: March 1, 1956 to September 1, 1956. I. B. Fieldhouse, J. C. Hedge, and T. E. Waterman. Oct. 3, 1956. 14p. Project title: HIGH TEMPERATURE MATERIAL PROPERTIES. Contract AF33(616)-2903. (AD-110526).

The objective of Part III of this program was the measurement of the thermal conductivity of sintered Ta, graphite type 7087, and graphite type GBH from 1000 to 3000°F. All measurements were made in the Heat Transfer Laboratory of the Propulsion and Fluid Mechanics Research Department. (auth)

2938

DIFFUSION OF RADIOACTIVE IONS IN CRYSTALS. APPLICATIONS. Marius Chemla. Ann. Phys. 1, 959-1002 (1956) Nov.-Dec.

A review is given of previous work including the fundamental laws, an experimental study of diffusion in solids, diffusion mechanisms, and theory. Experimental results are given concerning diffusion of P^{32} and S^{35} in NaCl and the migration of S^{35} in NaCl subjected to an electric field. Applications of such diffusion to methods of separating artificial radioelements without a driving device and to isotopic enrichment by migration in a solid subjected to an electric field are also discussed. (B.J.H.)

2939

EXPERIMENTAL ANALYSIS OF THE GENERAL THEORY OF RELATIVITY AND ARTIFICIAL SATELLITES. V. L. Ginzburg. Priroda 45, 30-9(1956) Sept. (In Russian)

2940

THE SPECIFIC HEAT AND ENTROPY OF LIQUID HELIUM THREE. S. M. Bhagat (Univ. of Delhi). Proc. Phys. Soc. B69, 1117-23(1956) Nov.

An 'imperfect gas' model for liquid He^3 has been developed. It appears that the observed specific heat and entropy of liquid He^3 can be explained, with good accuracy, by treating the liquid as an 'imperfect gas' with a number density some four times less than the actual number density of liquid He^3. Incidentally, one may also, at least qualitatively, account for the low degeneracy temperature expected from magnetic susceptibility measurements. (auth)

2941

A CALORIMETRIC DETERMINATION OF THE ENERGY REQUIRED TO PRODUCE AN ION PAIR IN AIR FOR COBALT-60 GAMMA-RAYS. J. P. Bernier, L. D. Skarsgard, D. V. Cormack, and H. E. Johns (Univ. of Saskatchewan and Saskatoon Cancer Clinic, Saskatoon). Radiation Research 5, 613-33(1956) Dec.

2942

ROTATION AND ANGULAR MOMENTUM OF MULTIPLE RADIATION FIELDS. Detlef Kamke (Aus dem Physikal-

ischen Institut der Universität Marburg/Lahn). Sitzber. Ges. Beforder. Ges. Naturw. Marburg 78, 83-95(1955) Jahrgang. (In German)

2943

ATOMIC AND ELECTRON HEAT OF THORIUM. Von K. Clusius and P. Franzosini (Physikalisch-Chemisches Institut der Universitat Zurich). Z. Naturforsch. 11a, 957 (1956) Nov. (In German)

AEROSOLS

2944

DEVICE FOR GENERATING RADIOACTIVE AEROSOLS. J. F. Pestaner and L. H. Gevantman (Chemical Technology Division, U. S. Naval Radiological Defense Lab., San Francisco, Calif.). Nucleonics 14, 38-9(1956) Dec.

The solid-aerosol generator described can be applied to fallout phenomena and other air-polution problems. (W.L.H.)

COSMIC RADIATION

2945

THE PENETRATING COMPONENT OF COSMIC RADIATION AT GREAT DEPTHS. Louis Avan. Ann. Phys. 1, 870-913(1956) Nov.-Dec.

A discussion of the experimental techniques used in studying the cosmic radiation included topics such as the treatment of the emulsions, radioactive contamination problems, sensitivity of the emulsions, and characteristics of the emulsions. Data are included on the intensity and angular distribution of μ mesons at great depths and on the nuclear interactions of μ mesons. (B.J.H.)

2946

A POSSIBLE CASE OF ANOMALOUS HYPERFRAGMENT BREAKUP. A. A. Varfolomeev, R. I. Gerasimova, and L. A. Karpova. Doklady Akad. Nauk S.S.S.R. 110, 758-60 (1956) Oct. 11. (In Russian)

A 56-layer stack of P-type emulsion bombarded in the stratosphere was used in the studies of unstable particles. One of the observed secondary stars was ascribed to the unstable fragment which decayed at an abnormally low energy. A particle a emitted from the primary star (18 + 4n type) and after passing 39μ decays emitting two charged particles b and c which stop in the emulsion after passing 15.5 + 0.3 mm and 4.5 + 0.5 μ, respectively. The angle between b and c is equal to 169 ± 4°. The traces b and c were analyzed and the case of the unstable particle was interpreted as associated with Λ^0 particle. Various possible schemes of fragment decays are discussed. (R.V.J.)

2947

EFFECTS OF A RING CURRENT ON COSMIC RADIATION. IMPACT ZONES. Ernest C. Ray (State Univ. of Iowa, Iowa City). Phys. Rev. 104, 1459-62(1956) Dec. 1.

An investigation of the effects of a ring current on the "0900" (geomagnetic local time) impact zone of flare-associated cosmic-ray intensity increases has been carried out using 55 trajectories calculated on an automatic computer. The particles considered have rigidities of 2 Bv, 6 Bv, and 10 Bv, and arrive at the earth from the vertical direction. Reasonable ring currents shift the longitude of impact by as much as half an hour from that predicted by the dipole theory. The shift may be in either direction, depending on the exact ring parameters chosen. Experimental data so far published are not sufficiently accurate to test the theory. Because of the finite width of observed impact zones together with the rather small shift predicted here, the experimental test is inherently difficult. (auth)

2948

MULTIPLE PRODUCTION OF STRANGE PARTICLES. Tsai-Chu and Max Morand (Faculte des Sciences, Sorbonne, Paris, France). Phys. Rev. 104, 1493(1956) Dec. 1.

An event was observed in an emulsion stack which involves at least 3 strange particles coming from a star of the type 14 + 5p. The charged strange particles identified are a hyperon Σ^- captured at the end of its trajectory, a hyperon Σ^+ decaying in flight, and a K^- meson interacting in flight. Detailed descriptions are given of the trajectories of these particles. (B.J.H.)

2949

CORRELATION OF METEOROLOGICAL PARAMETERS WITH COSMIC-RAY NEUTRON INTENSITIES. J. A. Lockwood and H. E. Yingst (Univ. of New Hampshire, Durham). Phys. Rev. 104, 1718-22(1956) Dec. 15.

The correlation of variations in the neutron intensity of cosmic radiation with variations in meteorological conditions has been investigated at 6262 ft and at sea level over the period from 1952 to 1955. A low-energy directional neutron detector was operated during the summer months of this period to monitor the intensity of neutrons with energies less than 0.5 ev. In addition a lead-paraffin pile detector was used to monitor the moderate energy neutrons. From the partial correlational analysis for the low-energy neutron intensity the following regression coefficients are obtained: barometric pressure (–10.9 ± 0.9) percent/cm Hg; specific humidity (–2.0 ± 2.5)%/0.01S, where S is the local specific humidity; local atmospheric temperature (–0.07 ± 0.09)%/F°. For the moderate-energy neutron detector the only significant regression coefficient obtained is for barometric pressure, α = (–9.70 ± 0.15)%/cm Hg. The results for the dependency of neutron intensity upon barometric pressure and temperature are in agreement with the predicted values, but the results for the specific humidity correlation do not agree with the theoretical predictions. The significance of the latter result is discussed. Experiments have also been made to determine the energy spectrum of low-energy neutrons at ground elevations by using paraffin moderators of different thicknesses placed over the low-energy directional neutron detector. The observed proportion of neutrons with energy exceeding 0.6 ev is less than predicted theoretically. (auth)

2950

DIRECT DETERMINATION OF PRIMARY COSMIC-RAY ALPHA-PARTICLE ENERGY SPECTRUM BY NEW METHOD. Frank B. McDonald (State Univ. of Iowa, Iowa City). Phys. Rev. 104, 1723-9(1956) Dec. 15.

The flux of cosmic-ray alpha particles has been measured at λ = 41°N and 55°N and the energy spectrum in the region 883 to 285 Mev/nucleon has been determined by the use of a combination of a scintillation and Čerenkov counter. This spectrum is not dependent on geomagnetic theory. It has been found that the integral alpha spectrum can be fitted with the function $J_{0\alpha}(E) = [431/(1 + E)^{1.44 \pm 0.2}]$ particles/m^2-sec-sterad, and $J_{0\alpha}(E_1) = 87 \pm 9$ particles/m^2-sec-sterad, λ = 41°N, $J_{0\alpha}(0.285 \text{ Bev}) = 292 \pm 25$ particles/m^2-sec-sterad, λ = 55°N. $J_{0\alpha}(E)$ is the flux of α particles at the top of the atmosphere with kinetic energy $\geq E$ (in Bev/nucleon). E_1 is the cutoff energy/nucleon for α particles at 41°N. An absorption mean free path $\lambda_\alpha = 45 \pm 7$ g/cm^2 has been measured for alpha particles. The properties of this new detector are discussed and a study is made of the energy response of the Čerenkov counter to fast multiply-charged particles. (auth)

2951

A LIQUID SCINTILLATOR INVESTIGATION OF THE SECOND MAXIMUM IN THE COSMIC RAY TRANSITION CURVE. P. D. McCormack (Dublin Inst. for Advanced

studies). Proc. Phys. Soc. (London), A69, 845-52(1956) Nov.

A liquid scintillator, designed to detect stars produced in the phosphor by the cosmic radiation at sea level, has been used to investigate the star transition curve at depths of lead absorber in the region of twenty centimeters. The anomalous maximum at a depth of twenty centimeters, first reported by Schopper, Höcker, and Rössle, has been confirmed. It appears that low energy μ mesons are the most likely primaries, the stars being produced by neutrons released in the slow μ meson nuclear absorption process. (auth)

2952

THE ENERGY SPECTRUM OF EXTENSIVE AIR SHOWERS. R. J. Norman (Univ. of Melbourne). Proc. Phys. Soc. (London), A69, 804-20(1956) Nov.

The integral shower density spectrum from 20 to 1000 particles per square meter is measured with three-fold proportional counters 60 meters above sea level. The density spectrum is analyzed, allowing for effects of shower age on structure to obtain the distribution in number $S(N) = 2.3 \times 10^{-4}\ (N \times 10^{-6})^{-1.47\pm0.1}\ m^{-2}h^{-1}$, with evidence for a rapid increase in exponent above $N = 10^6$ particles. Using cascade theory the latter is shown to be produced by a primary energy spectrum for $10^{13} < E < 10^{15}$, above which the exponent increases rapidly, reaching about -3 at $E = 10^{17}$ ev. (auth)

2953

THE DENSITY DISTRIBUTION OF EXTENSIVE SHOWERS. J. R. Prescott (Australian Atomic Energy Commission, Univ. of Melbourne). Proc. Phys. Soc. (London), A69, 870-4(1956) Nov.

Data concerning burst size distributions are published. (W.L.H.)

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

2954

STRUCTURAL HETEROGENEITY IN STAINLESS STEEL (AUSTENITIC) MICROGRAIN AT ELEVATED TEMPERATURES. V. I. Prosvirin. Izvest. Akad. Nauk S.S.S.R. Otdel. Tekh. Nauk No. 9, 117-20(1956) Sept. (In Russian)

Data are reported showing that heat treatment does not eliminate the chemical heterogeneity in complex solid solutions but increases it, causing considerable stratification of the solution. Methods of electrolytic etching and statistical distribution of microhardness were used in the investigation of austenitic steel (C–0.1%, Cr–23.0%, N–35.0%, Ti–1.2%, Nb–1.2%, Mo–0.6%, V–1.1%) at 1150 and 1250° temperature. (R.V.J.)

2955

DEFORMATIONS IN GERMANIUM CRYSTALLINE L TICE INDUCED BY FAST ELECTRON BOMBARDMENT. V. S. Vavilov, L. S. Smirnov et al. (Inst. of Physics). Zhur. Tekh. Fiz. 26, 1865-9(1956) Sept. (In Russian)

Studies were undertaken to find the relations between the cross-section deformations (hollow knots and atoms in the interjunctions) and the electron energies W, and, to obtain the data on the number of conduction-effecting energy levels, connected to the above mentioned crystalline deformations. Experiments were made with the electron-conducting Ge monocrystals bombarded by monoenergetic electrons ($\Delta W/W_0 < 8\%$) with energies from 400 to 1000 kev. The bombardment and measurements were carried out at room temperature. The relations of N-Ge specific conductivity to the energy W and the number of electrons are tabulated. (R.V.J.)

GASES

2956

PRECISION FLASH X-RAY DETERMINATION OF DENSITY RATIO IN GASEOUS DETONATIONS. Russell E. Duff and Herbert T. Knight (Los Alamos Scientific Lab., New Mexico). J. Chem. Phys. 25, 1301(1956) Dec.

2957

KINETIC THEORY OF WEAKLY IONIZED HOMOGENEOUS PLASMAS. III. COLLISION OPERATOR IN THE CASE OF AN IMPERFECT LORENTZ GAS. Michel Bayet, Jean-Loup Delcroix, and Jean-Francois Denisee. J. Phys. Radium 17, 923-30(1956) Nov.

2958

STUDY OF PLASMAS IN A TRANSIENT CONDITION. J. Salmon. J. Phys. Radium 17, 931-3(1956) Nov.

2959

'CLEAN-UP' OF RADIOACTIVE GASES USED FOR SURFACE STUDIES. C. Jech (Czechoslovak Academy of Science, Albertov 2030, Prague). Nature 178, 1343-4(1956) Dec. 15.

2960

COMPRESSION OF SOLIDIFIED GASES TO 20,000 kg/cm^2 AT LOW TEMPERATURE. John W. Stewart (Univ. of Virginia, Charlottesville). Phys. and Chem. of Solids 1, 146-58(1956) Nov.

The relative volume decrease as a function of pressure has been measured for solid He, H_2, D_2, and Ne at 4°K, for N_2 and A at 65°K, and for A at 77°K by the direct piston displacement method. The results for He and N_2 are new, while for the other gases earlier work has been confirmed and extended to higher pressure. Solid helium is found to be the most compressible solid yet measured, being reduced in volume by a factor of 2.7 by 20,000 kg/cm^2 pressure. A suspected phase transition in solid helium and a definite one for nitrogen at 65°K are discussed. The Murnaghan theory of finite strain leads to a convenient representation of all the experimental data. A direct determination of the density of solid argon at 77°K is also reported. (auth)

Refer also to abstract 3201.

INSTRUMENTS

2961 CREL-675

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

APPLICATIONS OF TRANSISTORS IN NUCLEONICS. F. S. Goulding. Oct. 2, 1956. 21p. (AECL-370).

The possible applications of transistors in nucleonics are briefly surveyed. Several diagrams of transistor circuits are included. (B.J.H.)

2962 HW-45711

Hanford Atomic Products Operation, Richland, Wash.

AN ION BEAM CHOPPER FOR TIME-OF-FLIGHT MEASUREMENTS. G. E. Driver. Oct. 1, 1956. 11p. Contract W-31-109-Eng-52. $0.15(OTS).

A description is given of an ion beam chopper which produces accurately spaced ion groups of 2 to 3 μsec duration and which generates synchronous timing pulses of a 2 μsec rise time. The system is part of a time-of-flight measurement facility. (auth)

2963 NACA-RM-E54G22a

Lewis Flight Propulsion Lab., Cleveland.

RECOVERY CORRECTIONS FOR BUTT-WELDED,

STRAIGHT-WIRE THERMOCOUPLES IN HIGH-VELOCITY, HIGH-TEMPERATURE GAS STREAMS. Frederick S. Simmons. 19p.

Recovery corrections were experimentally determined for several diameters of chromel-alumel and platinum 13% Rh–Pt butt-welded thermocuples in a gas stream at temperatures from ambient to 2000° R and Mach numbers from 0.2 to 1.0. The recovery corrections at various temperatures and pressures are reasonably correlated with an empirical equation in which the correction is seen to be proportional to the fifth root of the pressure and inversely proportional to the fourth root of the temperature. Probable errors in temperature measurement due to resultant uncertainties in the corrections are presented and discussed. (auth)

2964 OSR-TN-56-587

Stanford Research Inst., Menlo Park, Calif.

HEAT FLUX MEASUREMENTS AT THE SUN IMAGE OF THE CALIFORNIA INSTITUTE OF TECHNOLOGY LENS-TYPE SOLAR FURNACE. Technical Report No. V. (Report No. 8). Eugene Loh, Nevin K. Hiester, and Thomas E. Tietz. Sept. 14, 1956. 19p. SRI Project No. CU-1410. Contract AF18(600)-1499. (AD-110383).

Flux measurements were made at the focus of the CIT lens-type solar furnace using two U. S. Naval Radiological Defense Laboratory (NRDL) water-cooled radiometers. Maximum flux values were obtained for three cases: central lens only operating, central seven lenses operating, and finally, all lenses operating. For each of these cases, flux profiles were obtained by traversing the radiometer through the sun image. A maximum flux value of 220 cal/sec/cm^2 was recorded with all lenses operating. The direct solar radiation received at the furnace site at this time was about 1.04 cal/min/sq cm. Under these conditions the furnace operating efficiency was found to be 47.2%. The losses of 52.8% are ascribed to transmission losses in the lenses, reflectivity losses at the mirrors, the geometrical imperfection of the individual lenses and mirrors, and lack of perfect superposition of the nineteen images. (auth)

2965

FLYING SPOT COUNTING AND SIZING OF NON-UNIFORM PARTICLES. H. W. Loeb (A. Inst. P., Hivac Ltd., Harrow, Middlesex). Brit. J. Appl. Phys. 7, 440-1(1956) Dec.

A modified scanning principle involving a variable speed of scan is described which permits the extension of applicability of flying spot methods to particles, such as bubbles or droplets, characterized by a non-uniform degree of interception of the scanning beam. (auth)

2966

PHOTORECORDING INSTALLATION FOR THERMAL ANALYSIS. G. G. Tzurinov and V. Z. Kolodyazhnyĭ. Vestnik Akad. Nauk. S.S.S.R. 26, 35-7(1956) Oct. (In Russian)

A method affording visual observations with simultaneous photographic recording of the materials subjected to thermal analysis is described. The scheme of the photorecording device, the thermogram, and phase transformations of β,β'-dinitrooxidiethyl nitroamine are shown. (R.V.J.)

2967

HYDRAULIC SUPER-PRESSURE COMPRESSOR. A. A. Semerchan. Vestnik Akad. Nauk S.S.S.R. 26, 38-40(1956) Oct. (In Russian)

A description and scheme are given for a hydraulic compressor of 1200 l. of water capacity under 2,000 atm. and using 100 klw. The compressor was applied in the studies of physics and hydrodynamics of supersonic fluid streams (P = 2000 atm. the velocity is of 600 m/sec order). (R.V.J.)

ISOTOPES

2968 UCRL-3594

California. Univ., Berkeley. Radiation Lab.

DECAY SCHEME STUDIES OF SOME LIGHT GADOLINIUM ISOTOPES (thesis). Virginia Anne Schultz. Jan. 1957. 31p. Contract W-7405-eng-48. $0.30(OTS).

Information on the excited levels in $Eu^{147,149,151,\text{ and }153}$ was obtained by studying the photon and conversion electron spectra of Gd activities produced by α particle bombardments on Sm and deuteron bombardments on Eu. A new isotope decaying by electron capture with a 29 hour half life was found and characterized as Gd^{147}. Sixteen γ transitions were found for Gd^{147}, of which the strongest are ones of 229.49 and 396.21 kev. Of sixteen transitions found for Gd^{149}, the strongest occur at 149.86, 298.79, and 346.70 kev. Nine transitions were found for Gd^{151} and Gd^{153} combined, seven for a probable isomer of one of the isotopes, and eight for Eu daughters. Relative photon and electron intensities were determined for some of the transitions, coincidence measurements were made, and accurate transition energies were measured. Multipolarities for a few of the transitions are assigned and a tentative decay scheme for Gd^{149} is suggested. (auth)

2969

CONCERNING THE SEARCH FOR Sr AND Y ISOTOPES FROM U FISSION. Von Günter Herrmann and Fritz Strassmann (Aus dem Anorganisch-Chemischen Institut der Universität Mainz). Z. Naturforsch. 11a, 946-54(1956) Nov. (In German)

Refer also to abstract 3212.

ISOTOPE SEPARATION

Refer to abstract 2850.

MASS SPECTROGRAPHY

2970

ION DETECTION WITH THE SCINTILLATION DETECTOR IN A MASS SPECTROSCOPE. Von E. Schönheit (Aus dem I. Physikalischen Institut der Freien Universität Berlin). Z. Naturforsch. 11a, 819-23(1956) Oct. (In German)

MATHEMATICS

2971 MURA-30

Wayne Univ., Detroit and [Midwestern Universities Research Assn., Urbana, Ill.].

AN ADIABATIC THEOREM FOR MOTIONS WHICH EXHIBIT INVARIANT PHASE CURVES. Keith R. Symon. Aug. 4, 1954. 6p. (KRS-MURA-3).

An adiabatic theorem is proved assuming that a constant of the motion $\alpha(p,q,\lambda,t)$ which is periodic in t exists. It is shown under these conditions that for slow changes of the parameter λ, a set of particles all lying initially on one invariant curve in phase space will continue to lie all on some invariant curve. (auth)

2972 ORNL-2230

Oak Ridge National Lab., Tenn.

GENERATED ERROR IN THE SOLUTION OF CERTAIN PARTIAL DIFFERENCE EQUATIONS. Alston S. Householder. Dec. 28, 1956. 40p. Contract W-7405-eng-26. $0.30(OTS).

2973 ORNL-2241
Oak Ridge National Lab., Tenn.
ON THE SOLUTION OF A FREDHOLM INTEGRAL EQUATION. Carl L. Gerberich. Jan. 3, 1957. 62p. Contract W-7405-eng-26. $0.40(OTS).

Refer also to abstract 2994.

MEASURING INSTRUMENTS AND TECHNIQUES

2974 AECD-3761
Los Alamos Scientific Lab., N. Mex.
NEUTRON DISTRIBUTIONS MEASURED WITH BETA DECAYS AND PHOTOGRAPHIC EMULSIONS. Dwight S. Young. [1956?]. Decl. Dec. 6, 1956. 11p. Contract [W-7405-eng-36]. $3.30(ph OTS); $2.40(mf OTS).

A method has been developed for observing the "fine structure" of neutron flux distribution. Differences in neutron flux in regions a half a millimeter apart have been measured. Examples in which this resolution has been useful are given. In the case of a polythene ball, three-fourths of an inch in diameter, in the center of the Little Eva reactor, the effective neutron flux varies 75% of the unperturbed value between two readings a tenth of an inch apart. (auth)

2975 ANL-5642
Argonne National Lab., Lemont, Ill.
ARGONNE 7.7-METER BENT CRYSTAL GAMMA-RAY SPECTROMETER. David Rose, Herbert Ostrander, and Bernard Hamermesh. Dec. 1956. 112p. Contract W-31-109-eng-38. $0.60(OTS).

A bent crystal gamma-ray spectrometer of the transmission type having a focal length of 7.7 meters has been built for studying neutron-capture radiation. The source is placed inside the reactor CP-5 in a horizontal straight-through hole. The instrument is designed to utilize a 30 cm × 30 cm quartz plate cut normal to the 310 planes. Undiffracted radiation is absorbed by a baffle consisting of 108 Pb plates each 40 × 11 × 0.040 inches mounted between tapered spacers so as to focus on the virtual image of the source. The detector is an array of 16 NaI (Tl) crystals comprising a volume $10\frac{1}{2} \times 10\frac{1}{2} \times 2$ in. The drive system rotates the crystal one second of arc in 20 seconds. The 2:1 motion required between the crystal and the detector is maintained by an optical lever system. The Bragg angle is measured with an interferometer and the gamma-ray energy may be determined relative to the Hg^{198} green line. The instrument now operates with a 10 × 15 × 0.6 cm crystal. (auth)

2976 CRT-668
Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.
ON THE DESIGN OF AN IRON-FREE $\sqrt{2\pi}\,\beta$-SPECTROMETER. G. E. Lee-Whiting and E. A. Taylor. Oct. 1956. 77p. (AECL-381).

The expansion coefficients of that magnetic field which gives best focusing in the high-aperture double-focusing spectrometer were determined to the sixth order. The analytical calculations were checked by numerical integration of the orbit equations. Tables of the numerical values of the vector-potential expansion coefficients for various forms of fields are given in appendices. Details are given of the design of a spectrometer to be constructed from three pairs of air-cored coils. Methods of calculating the effects of various coil perturbations on the focusing are also discussed. (B.J.H.)

2977 GPI-36
Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.
HALOGEN COUNTER TYPE DH-1. OPERATIONAL DATA. I. L. Fowler. May 1956. 18p.

The DH-1 Counter is a small, γ sensitive, halogen quenched, geiger counter, with a relatively low operating voltage. Its main use is in health monitors or contamination meters with ranges up to about 50 mr/hr. Operating with a current indicator the counter may be used to detect or monitor radiation fields in the range 0.2 r/hr to 10 r/hr. In a combination count-rate and current circuit, measurements may be made from background to at least 5 r/hr. Operational characteristics are summarized. (auth)

2978 HW-43080
Hanford Atomic Products Operation, Richland, Wash.
STANDARDIZATION AND IMPROVEMENTS IN DESIGN OF CUTIE PIE AND JUNO RADIATION SURVEY EQUIPMENT. L. M. Palmer. Apr. 1, 1956. 43p. Contract W-31-109-Eng-52. $0.30(OTS).

The Cutie Pie and Juno are dose rate type instruments for the detection and measurement of β and γ radiation. The Juno has the additional feature of a thin window for the detection of α particles. The primary detector of both instruments is an ionization chamber of the unsealed air-filled type and is permanently attached. Radiation particles passing through the chamber produce ions, which are collected between the charged surfaces of the chamber to produce a small current. The current passing through a resistance of 10^{9} ohms or less, produces a d-c voltage at the input of a single-tube d-c amplifier and can be read on a 3-in. meter in terms of mr/hr or other rate scales predetermined by the input resistor values. The Cutie Pie and Juno have three normal ranges of 50, 500, and 5000 mr/hr. Simplified schematic drawings of basic circuit components are presented. Design changes, and the basis for these changes are discussed. (C.H.)

2979 KAPL-1410
Knolls Atomic Power Lab., Schenectady, N. Y.
A METHOD OF MEASURING THE FLUX OF INTERMEDIATE ENERGY NEUTRONS. L. H. Weinberg. Oct. 31, 1955. Changed from OFFICIAL USE ONLY Nov. 23, 1956. 20p. Contract W-31-109-Eng-52. $0.20(OTS).

A relatively straightforward method of obtaining the magnitude of the flux of intermediate energy neutrons from measurements made with a paraffin-covered BF_3 counter (long counter) is described. The method requires that the BF_3 counter be appropriately calibrated, preferably in paraffin, so that the average thermal neutron flux in the paraffin of the long counter can be measured. A simple calculation then yields the intermediate energy neutron flux. The method is most valid for cases in which the intermediate neutron flux (between thermal and about 250 Kev) is large in comparison with the fast neutron flux (above about 250 Kev). (auth)

2980 MonC-416
Clinton National Lab., Oak Ridge, Tenn.
THE SWEEP TYPE, DIFFERENTIAL ALPHA ENERGY ANALYSER. J. Howard Parsons. Oct. 28, 1947. Decl. July 30, 1954. 52p. Contract W-35-058-eng-71.

A new type of α energy analyser has been developed for the analysis of samples of α emitters. This instrument differs from former analysers in the method of determining the energy distribution curve. The energy distribution curves are automatically determined and plotted in a form that allows easy interpretation. Half widths of less than 60 kev have been obtained with these instruments. The operation of the instrument is herein described. The construction details, service procedure, installation instructions, and operator's manual are included. (auth)

2981

A TRANSIT DOSE TECHNIQUE FOR THE DETERMINATION OF DOSES IN INHOMOGENEOUS BODIES. J. E. O'Connor (St. Luke's Hospital, Dublin). Brit. J. Radiol. 29, 663-7 (1956) Dec.

2982

INSTRUMENTAL AND TECHNICAL NOTE. AN ISODOSE PLOTTER OF SIMPLE DESIGN. I. M. Rosman and K. G. Zimmer (Universitats-Frauen-Klinik, Hamburg-Eppendorf). Brit. J. Radiol. 29, 688(1956) Dec.

2983

AN ATTEMPT TO ASSESS THE DOSAGE OF STRONTIUM 90 RECEIVED BY YOUNG RABBIT BONE. R. Oliver and Janet Vaughan (Department of Radiotherapy and Nuffield Department of Medicine, Churchill Hospital, Oxford). Brit. J. Radiol. 29, 668-72(1956) Dec.

In young rabbits radioactive strontium is concentrated in areas of active bone growth. The radiation dose is closely related to percentage retention per gram of bone. Calculation of radiation dose based on such observed retention shows that the dose actually received in certain areas may be appreciably greater than if a uniform distribution of the isotope were assumed. These calculations only establish the principle that an uneven distribution in bone must be assumed in calculations of radiation hazards. The absolute results in any species would vary according to age, size and species retention pattern. (auth)

2984

FABRICATION OF α SCINTILLATORS INSENSITIVE TO SURROUNDING LIGHT. Bernard Mougin and Yves Koechlin. J. Phys. Radium 17, Suppl. 135A-6A(1956) Nov.

A description is given of the fabrication methods for scintillator screens to be used for α counting. These scintillators are composed of a Ag-activated ZnS screen, deposited on a transparent support, and covered with an Al seal. This seal, of a thickness 0.8 mg/cm^2, can be traversed by α particles while it is completely opaque to surrounding light. A scintillation counter equipped with such a screen has a quantitative yield of 30% for uranium α particles. (tr-auth)

2985

SCINTILLATION-DETECTOR DOORWAY MONITOR. D. A. Campbell and L. D. Test (Instrument Research and Development Operation, Hanford Atomic Products Operation, General Electric Company, Richland, Washington). Nucleonics 14, No. 12, 39-40(1956) Dec.

To augment routine manual monitoring of personnel clothing for radioactive contamination, a doorway monitor was designed to automatically detect hard β contamination. (W.L.H.)

2986

A SCINTILLATION COUNTER FOR SOFT-β PAPER CHROMATOGRAMS. K. Steenberg and A. A. Benson (Radiation Lab., Univ. of California, Berkeley, Calif.). Nucleonics 14, No. 12, 40-3(1956) Dec.

A large-diameter scintillation counter useful for measurement of the soft β emitters C^{14}, S^{35}, and Ca^{45} in radiochromatograms is described. (W.L.H.)

2987

ALPHA-GAMMA COINCIDENCE COUNTING FOR FLOW-COUNTER CALIBRATION. W. S. Lyon and S. A. Reynolds (Oak Ridge National Lab., Tenn.). Nucleonics 14, No. 12, 44, 46 and 48(1956) Dec.

Alpha-gamma coincidence counting is a new absolute method for determining the efficiency of an α counter. It has been applied to the calibration of flow-type proportional counters. (W.L.H.)

2988

LAUNDRY MONITOR FOR ALPHA CONTAMINATION. F. D. Ryder (Instrument Development Div., Savannah River Lab., E. I. du Pont de Nemours & Co., Aiken, S. C.). Nucleonics 14, No. 12, 50-1(1956) Dec.

2989

A CALIBRATION OF THE FRICKE CHEMICAL DOSIMETER. H. C. Sutton (Univ. of Otago Medical School, Dunedin, N. Z.). Phys. in Med. and Biol. 1, 153-60(1956) Oct.

2990

A CALORIMETRIC METHOD USED IN THE DOSIMETRY OF X-RAY BEAMS FROM A 1 MILLION VOLT GENERATOR. G. W. Dolphin and G. S. Innes (St. Bartholomew's Hospital Medical College, London). Phys. in Med. and Biol. 1, 161-74(1956) Oct.

2991

THE DEVELOPMENT OF A CHEST PHANTOM FOR USE IN RADIOLOGIC DOSIMETRY. John H. Harris, Jr. (Hospital of the Univ. of Pennsylvania); William J. Tuddenham (Hospital of the Univ. of Pennsylvania); Leonard Stanton (American Oncologic Hospital, Philadelphia); Frank Glauser (Graduate School of Medicine, Univ. of Pennsylvania) and Eugene P. Pendergrass (Hospital of the Univ. of Pennsylvania). Radiology 67, 805-14(1956) Dec.

2992

RADIOCARBON AGE ESTIMATES OBTAINED BY AN IMPROVED LIQUID SCINTILLATION TECHNIQUE. R. W. Pringle, W. Furchinetz, B. L. Funt, and S. S. Danyluk, (Univ. of Manitoba, Winnipeg, Canada). Science 125, 69-70 (1957) Jan. 11.

The use of trimethyl borate prepared from sample carbon in the liquid scintillator simplifies C^{14} dating procedures, and the accuracy achieved approaches that of the gas-counting techniques. (T.R.H.)

Refer also to abstract 2802.

MESONS

2993 MURA-207

Midwestern Universities Research Assn., Urbana, Ill. ENERGY OF COLLIDING PROTON BEAMS AND ANGULAR DISTRIBUTION OF MESONS PRODUCED. Tsu-shen Chang. [1956]. 22p. Contract AT(11-1)-384. $4.80(ph OTS); $2.70(mf OTS).

Numerical calculations were carried out for the energies available in the center of mass system of two protons of energy, 20 Bev each, colliding at various angles in the laboratory system, and the velocities of the center of mass for such collisions. Formulas for angular distributions of mesons produced in the laboratory system have been derived by assuming certain angular distributions for monoenergetic mesons in the center of mass system, corresponding to two cases of high energy proton-proton collisions (i) oblique collisions of two proton beams of same incident energy and (ii) head-on collisions of two proton beams of different incident energies. Numerical calculations for these meson angular distributions were confined to oblique collisions of two proton beams of 20 Bev each at and angle 120° and head-on collisions of two proton beams, one with 20 Bev while the other has incident energy 10 Bev in the laboratory system. (auth)

2994

ON THE CHAIN SYSTEMS IN MESON FIELDS. I. S. Arzhanykh. (Pomanovskii Inst. of Mathematics and Me-

chanics.) Doklady Akad. Nauk S.S.S.R. 110, 351-5(1956) (In Russian)

The system of meson field equations was studied for mesons with various mass, velocities, and charges. Two variations of the problem were analyzed. The field with mass spectrum with equal meson velocities and the field with spectrum velocities for a given particle mass. (R.V.J.)

2995

DISPERSION EQUATIONS FOR THE REACTIONS OF THE π-MESON PHOTOPRODUCTIONS. A. A. Logunov and B. M. Stepanov (Steklov Inst. of Mathematics). Doklady Akad. Nauk S.S.S.R. 110, 368-70(1956) Sept. 21. (In Russian)

2996

METHOD OF ANALYSIS OF CHARGED PION PHOTOPRODUCTION. Michael J. Moravcsik (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 104, 1451-3(1956) Dec. 1.

It is explained why the usual analysis of the angular distribution of charged pion photoproduction with the help of a quadratic expression of $\cos\theta$ (θ being the meson emission angle) is physically meaningless. A substitute scheme is proposed in which the angular distribution in the center-of-mass system, multiplied by $(1-\beta\cos\theta)^2$ (β being the meson velocity), is analyzed by a quartic expression in $\cos\theta$. Such an analysis is given for several theories commonly in use. (auth)

2997

HEAVY MESON LIFETIMES. J. Orear, G. Harris, and S. Taylor (Columbia Univ., New York). Phys. Rev. 104, 1463-6(1956) Dec. 1.

Two identical nuclear emulsion stacks were exposed at different distances to the 114-Mev Bevatron K^+ beam using the same geometry and Bevatron conditions. A comparison of the K_L to τ-meson ratios in the two stacks combined the known lifetimes of the $K_{\pi 2}$ and $K_{\mu 2}$ gives $(1.18^{+0.32}_{-0.25}) \times 10^{-8}$ sec for the τ^+ lifetime. The ratio of the $K_{\pi 2}{}^+$ to the τ^+ lifetime is then 1.03 with a root-mean-square error of ±29%. Thus the τ and the $K_{\pi 2}$, which according to Dalitz-type analysis should be different particles, have the same lifetime within experimental errors. The τ and K_L lifetimes can be obtained by a second method which does not rely on any previous lifetime information. In this method the ratios of the heavy meson fluxes to the proton and pion beam fluxes are compared. The results obtained by this method are $(1.04^{+0.42}_{-0.25}) \times 10^{-8}$ sec for the τ^+ lifetime and $(1.11^{+0.18}_{-0.11}) \times 10^{-8}$ sec for the $K_1{}^+$ lifetime. Alternate τ and $K_{\mu 3}$ fluxes in the two stacks also indicate a lifetime of about 10^{-8} sec. (auth)

2998

PARITY CONJUGATION AND HYPERFRAGMENTS. S. B. Treiman (Univ. of Wisconsin, Madison). Phys. Rev. 104, 1475-7(1956) Dec. 1.

The parity conjugation scheme recently proposed by Lee and Yang entails that Λ-hyperfragments should exist as parity doublets, so that a given species of hyperfragment should exhibit two distinct lifetimes, corresponding respectively to the degenerate even- and odd-parity hyperfragment state functions. Likewise there should be two distinct ratios of nonmesonic to mesonic decay. The parity exchange interaction of Λ particles and nucleons, $\Lambda_1 + n \rightleftharpoons \Lambda_2 + n$ (where Λ_1 and Λ_2 are the two members of the Λ particle parity doublet), gives rise to the possibility of interesting interference effects in hyperfragment decay. (auth)

2999

SEARCH FOR DOUBLE STARS PRODUCED BY FAST π-MESONS. W. F. Fry and D. C. Wold (Univ. of Wisconsin, Madison). Phys. Rev. 104, 1478(1956) Dec. 1.

Nuclear emulsions, exposed to 220-Mev π^- mesons, were searched for double stars which could be due to a π^- meson trapped in a mesonic orbit about a nuclear fragment. No fragment disintegrations were observed from 7000 fast π-meson stars. (auth)

3000

CLOUD-CHAMBER STUDY OF NEGATIVE STRANGE PARTICLES. G. H. Trilling and G. Neugebauer (California Inst. of Technology, Pasadena). Phys. Rev. 104, 1688-94 (1956) Dec. 15.

A detailed analysis of the decays in flight of negative K mesons and hyperons, obtained with the 48-in. cloud chambers in Pasadena, is presented. The principal results are the following. Two new fully measurable τ^- events add to the already strong evidence for the existence of this particle. K^- events with a single charged secondary are shown to be most consistent with the $K_{\pi 2}$ and $K_{\mu 2}$ decay modes. An analysis of 7 Caltech Ξ^- events is shown to lead to a Q value of 65 ± 3 Mev, and a 50% confidence lower limit to the lifetime of 4.6×10^{-10} sec. A rough upper limit to the lifetime of 2×10^{-8} sec, based on the predictions of the strangeness theory, is obtained. Angular correlations among the Ξ^- secondaries are studied, but the statistics are insufficient to permit any significant conclusion. An additional event which is most easily interpreted as a Ξ^- decay is discussed. The V^- events which are neither K^- nor Ξ^- are shown to have a lifetime less than or equal to $(1.52^{+0.38}_{-0.25}) \times 10^{-10}$ sec and a P* value, based on their transverse momentum distribution, of 197 ± 7 Mev/c. These values correspond satisfactorily with the presently known properties of the Σ^- hyperon. It is estimated from a comparison of the numbers of identified Ξ^-'s and V^-'s that the fraction of Λ^0 particles which decay into charged secondaries is greater than $0.40^{+0.15}_{-0.11}$, and can, insofar as the present data are concerned, be as high as unity. All errors quoted in the above results are 50% confidence limits. (auth)

3001

ELASTIC SCATTERING OF 78-Mev PIONS FROM COPPER. Ross E. Williams, Winslow F. Baker, and James Rainwater (Columbia Univ., New York). Phys. Rev. 104, 1695-1702(1956) Dec. 15.

The angular distributions of 78 ± 5 Mev π^- and π^+ mesons scattered elastically from copper have been measured. The experimental results are compared with the distributions found from a range of exact optical model phase shift calculations using a complex attractive square well potential for $r < R_0$ (where $R_0 = 1.4A^{1/3} \times 10^{-13}$ cm) and the Coulomb potential for $r > R_0$. The effect of adding to the potential a term depending upon the gradient of the nuclear density, and thereby introducing a discontinuity in the matching of logarithmic derivatives at $r = R_0$, is also explored. The optical model as well as several modified Born approximation calculations show reasonable agreement with the experimental curve in the forward direction and in the region of the first diffraction maximum. At backward angles the calculated curves show pronounced maxima and minima which do not appear experimentally, perhaps because incoherent transitions at these angles mask the true coherent distribution in the experimental measurement. (auth)

3002

CLOUD-CHAMBER STUDY OF THE PRODUCTION AND DECAY OF STRANGE PARTICLES. G. H. Trilling and R. B. Leighton (California Inst. of Technology, Pasadena). Phys. Rev. 104, 1703-10(1956) Dec. 15.

Out of 1242 decay events observed in a magnetic cloud chamber array triggered on penetrating showers, a total of 54 associated V-particle pairs has been obtained. All the associations observed are consistent with the "strangeness" selection rules. A statistical analysis of the num-

bers of double and single events has been used to obtain rough estimates of the fractions of neutral K particles and neutral hyperons which decay by "invisible" modes, and of the relative frequencies of occurrence of various production processes. The main uncertainties in the resulting values are discussed in detail. (auth)

3003

PROCEEDINGS OF THE CERN SYMPOSIUM ON HIGH ENERGY ACCELERATORS AND PION PHYSICS HELD IN GENEVA, JUNE 11-23, 1956. VOLUME 2. PION PHYSICS. A. Citron, G. von Dardel, B. d'Espagnat, Y. Goldschmidt-Clermont and C. Peyrou, eds. Geneva, European Organization for Nuclear Research, 1956. 443p. Price: 40 Frs.

Papers on bubble chamber detectors include those on the University of Michigan bubble chamber program, liquid H bubble chambers, a H bubble chamber for low-energy meson scattering, ionizing capacity of particles in a bubble chamber, n-pentane bubble chambers, and bubble chamber control and construction. Papers are also included on other track chambers such as fast-cycling cloud chambers, an over-compression chamber, a multiplate cloud chamber, an electronic scanner for nuclear emulsions, and the hodoscope chamber. Discussions were given of fast counter techniques such as Cherenkov counters, millimicrosecond counting techniques, multilayer proportional counters, and neutron time-of-flight techniques in the 100-Mev region. Papers were given on the antiproton work at Berkeley and on antiprotons in emulsions exposed to cosmic rays. Discussions were also held on nucleon-nucleon scattering experiments including the elastic scattering of 580-Mev neutrons, proton scattering, and the polarization of 600-Mev protons. Papers on the theoretical aspects of pion physics include those on meson generation in collisions of high-energy nucleons, γ radiation from pion-nuclei collisions, photoproduction theory, the fixed source meson theory, and dispersion theory. The mathematical consistency of quantum electrodynamics is also discussed. Papers were also given on pion-nucleon scattering, on the photo-production of mesons, and on pion production by nucleons. Discussions of mesonic atoms include those on proportional counter measurements of π mesonic x rays, yields and energies of mesonic x rays, and the lifetime of negative mesons in various materials. (B.J.H.)

Refer also to abstract 3199.

MOLECULAR PROPERTIES

3004

PARAMAGNETIC RESONANCE AND POLARIZATION OF NUCLEI IN METALS. I. M. Lifshitz, M. Ya. Azbel', and V. I. Gerasimenko (Physical-Technical Inst., Academy of Science of the Ukrainian S.S.R., Kharkoff). Phys. and Chem. of Solids 1, 164-74(1956) Nov.

A theory of paramagnetic resonance in metals is constructed, based on a simultaneous solution of Maxwell's equations and of the kinetic equation for the density operator. The polarization of the nuclei in the metal is determined. It is shown that this polarization always varies slowly with depth, diminishing as $\exp(-z/\delta_{eff})$, where $\delta_{eff} \sim v\sqrt{(t_0 T_1)} \sim 10^{-2}$ to 1 cm is the mean distance travelled by an electron between collisions in which its spin is reversed. It is found that in paramagnetic resonance there is a selective transparency of metallic films, and the transmitted wave is circularly polarized, if the constant magnetic field is normal to the surface. (auth)

NEUTRONS

3005 KAPL-M-WBW-2

Knolls Atomic Power Lab., Schenectady, N. Y.

PRELIMINARY DIFFUSION LENGTH MEASUREMENTS IN HOT WATER. W. B. Wright and R. T. Frost. Oct. 31, 1956. 18p. Contract W-31-109-Eng-52. $3.30(ph OTS); $2.40(mf OTS).

Preliminary values of the thermal neutron diffusion length in water were found to be 2.714 ± 0.010, 3.927 ± 0.023, and 5.360 ± 0.037 cm at 77, 374, and 530°F, respectively. Neutrons from the TTR were used in the experiment and neutron fluxes were measured by activation of Dy foils. (B.J.H.)

3006

NEUTRONS FROM THE D-D REACTIONS. L. Cranberg, A. H. Armstrong, and R. L. Henkel (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 104, 1639-42(1956) Dec. 15.

An investigation has been made of the neutron spectra resulting from D-D reactions for a range of incident deuteron energies of 4.75 to 7.33 Mev, using a pulsed-beam time-of-flight method. In addition to monoenergetic neutrons from the reaction $D(d,n)He^3$, a continuum of neutrons is observed corresponding to D(d,np)D. The yield of the latter reaction has been measured at about 0.5-Mev intervals at zero degrees, and at an energy of 6.3 Mev an angular distribution has been obtained for both reactions. At 6.3-Mev deuteron energy and at zero degrees the yield of the continuum for for neutron energies above 0.95 Mev is 17% of the yield of monoenergetic neutrons. The yield from both reactions is strongly forward in the laboratory reference frame, and for the breakup process increases rapidly with increase in energy above threshold. (auth)

NUCLEAR PHYSICS

3007 LAMS-1522

Los Alamos Scientific Lab., N. Mex.

NOTES ON EVAPORATION OF TARGET MATERIALS. J. A. Northrop and R. H. Stokes. Mar. 1953. Decl. Dec. 10, 1956. 25p. Contract W-7405-eng-36. $4.80(ph OTS); $2.70(mf OTS).

The general utility of vacuum evaporated films is discussed. The characteristics that make this technique most useful are the uniformity of the films, the easy control of their thickness over a large range, and the adaptability of the system to different metals and compounds. The design of a vacuum evaporator should provide adequate pumping speed, cooling of components, filament heater supply, and general flexibility and adaptability of the components to different materials. The design of filaments or boats and the evaporation of Al, Ag, Au, Li, Na, UCl_4, ThF_4, Be, SiO, NaI(Tl), U, and UO_2 are considered. Special attention is given to the problem of obtaining uniform layers of UO_2 on a large, flat target relatively close to the source. (auth)

3008 NP-6150

Pittsburgh. Univ. Sarah Mellon Scaife Radiation Lab.

PRECISION SCATTERING OF NUCLEAR PARTICLES. [PART] 1. HELIUM EXCITATION CROSS SECTIONS NEAR THRESHOLD. Elizabeth Baranger and Edward Gerjuoy. [PART] 2. DEUTERON-INDUCED REACTIONS IN NITROGEN AND HELIUM. Technical Report No. VII. Ernest Keeling Warburton. Nov. 1956. 107p. Project Nos. NR022-068 and NR019-509. Contracts N7onr-32505 and NOnr-624(00)(05).

Experimental cross sections for He excitation near threshold are compared to those predicted by the Breit-Wigner formula. A 47-in. cyclotron was used as a source of 14.8-Mev deuterons in the study of deuteron-induced reactions in N and He. Energy analysis of the reaction particles emerging from the scattering chamber was accomplished by a reaction particle magnet. The reactions investigated were $N^{14}(d,p)N^{15}$, $N^{15}(d,p)N^{16}$, $N^{15}(d,\alpha)C^{13}$, $N^{14}(d,t)N^{13}$, and $He^4(d,p)He^5$. (B.J.H.)

3009 OSR-TN-55-203

Minnesota. Univ., Minneapolis. School of Chemistry. NUCLEAR AND ELECTRONIC SPIN MAGNETIC RESONANCE. John E. Wertz. May 1955. 193p. Project R-351-40-9. Contract AF18(600)-479. (AD-67517).

The principles, experimental procedures, and applications of the spin resonance of nuclei and of nearly-free electrons are reviewed. A total of 640 references to the literature is included. (B.J.H.)

3010

DETERMINATION OF THE SIGNS OF NUCLEAR SPIN-SPIN INDIRECT COUPLING CONSTANTS. G. A. Williams and H. S. Gutowsky (Univ. of Illinois, Urbana). J. Chem. Phys. 25, 1288-9(1956) Dec.

3011

TABLES OF THE CLASSICAL ORBITAL INTEGRALS IN COULOMB EXCITATION. Kurt Alder and Aage Winther. Kgl. Danske Videnskab. Selskab., Mat.-fys. Medd. 31, No. 1, 1-74(1956).

In the classical description of the Coulomb excitation process one is led to some non-elementary definite integrals. These integrals can also be used in a more refined treatment, which is related to the WBK method, for the calculation of the quantum mechanical corrections. This paper contains a collection of formulae, mathematical properties, and asymptotic expansions of these integrals. An explicit tabulation of the integrals for a large range of the interesting parameters is given. (auth)

3012

"CLASSICAL" NUCLEAR PHYSICS IN THE USSR. F. Ajzenbert-Selove (Boston Univ., Mass.). Nuovo cimento (10) 4, Suppl., 2-30(1956).

An attempt is made to review Soviet work in classical nuclear physics in the past two and one half years. The subjects covered include α, β, and γ spectroscopy; induced nuclear reactions; masses, binding energies, and abundances; and, theories of nuclear structure. Experimental techniques used and results are listed. A bibliography is also included. (B.J.H.)

3013

RESEARCH ON NUCLEAR PHYSICS AND HIGH ENERGY PHYSICS IN THE USSR. M. Hamermesh (Argonne National Lab., Lemont, Ill.). Nuovo cimento (10) 4, Suppl., 65-83 (1956).

A review is given of research on nuclear physics and high-energy physics in the USSR. Topics in high-energy physics include p-p scattering, neutron scattering, meson production, high-energy fission and the photoeffect. Topics in nuclear physics include spontaneous fission of Th, properties of neutrons, and the instability of H^4. Discussions are also included on instrumentation, such as bubble chambers and electrostatic generators, and on reactor physics. A bibliography is included. (B.J.H.)

3014

HYDROGEN ATOM IN A STRONG MAGNETIC FIELD. Y. Yafet, R. W. Keyes, and E. N. Adams (Westinghouse Research Labs., Pittsburgh). Phys. and Chem. of Solids 1, 137-42(1956) Nov.

The energy levels and wave functions are studied for a hydrogen atom in a very strong magnetic field. The contraction of the electronic-charge distribution in a plane perpendicular to the magnetic field results in an increase in ionization energy at high fields. Conditions are favorable for observing the effect in the case of impurity states in a semiconductor of high dielectric constant and low effective mass, to which the theory is applied in detail. Changes in the optical and electrical properties are predicted. (auth)

3015

NEUTRON POLARIZATION IN (p,n) REACTIONS AND NUCLEAR OPTICAL MODEL. J. Sawicki (Univ. of Warsaw, Poland). Phys. Rev. 104, 1441-4(1956) Dec. 1.

The polarization of the neutron produced in a (p,n) reaction is calculated under the assumption of a direct mechanism for the reaction. The "cloudy crystal ball" potential modified by the spin-orbit coupling term is assumed to be the neutron-nucleus interaction. The model is applied to the reaction $Si^{29}(p,n)P^{29}$ for $E_p = 6$ and 6.5 Mev. The maximum negative polarizations $\sim -75\%$ come in for the center-of-mass scattering angle $\theta \sim 75°$. (auth)

3016

SPIN RELAXATION PROCESSES IN A TWO-PROTON SYSTEM. N. Bloembergen (Harvard Univ., Cambridge, Mass.). Phys. Rev. 104, 1542-7(1956) Dec. 15.

The general theory of nuclear spin relaxation, based on the Boltzmann transport equation for the density matrix, is applied to the very simple, nontrivial system of two identical spins $I = \frac{1}{2}$. A proton pair undergoing hindered rotation around one axis shows a resolvable doublet. The relaxation processes in this doublet are investigated. Explicit formulas for the longitudinal and transverse relaxation times are derived, which display a dependence on the angles of the axis of rotation with the external magnetic field and the radius vector. Experimental evidence for this dependence is discussed. General expressions for the Overhauser and saturation effects with two applied radio-frequency fields are given, which may also be applied to a magnetic ion or nucleus with I = 1 and crystalline field splitting. (auth)

3017

HYPERFINE STRUCTURE OF THE METASTABLE DEUTERIUM ATOM. Haskell A. Reich, Juergen W. Heberle, and P. Kusch (Columbia Univ., New York). Phys. Rev. 104, 1585-92(1956) Dec. 15.

The hyperfine separation $\Delta\nu(2S;D)$ of the metastable $2\,^2S_{\frac{1}{2}}$ state of the deuterium atom has been measured by an atomic-beam magnetic-resonance method that has been described previously. It was found that $\Delta\nu(2S;D) = 40{,}924.439 \pm 0.020$ kc/sec. From this result and the ground-state separation $\Delta\nu(1S;D)$ R(D) was found to be $\equiv \Delta\nu(2S;D)/\Delta\nu(1S;D) = \frac{1}{8}$ (1.000 034 2 ± 0.000 000 6). Comparison of this value with the corresponding quantity for hydrogen, R(H) = $\frac{1}{8}$(1.000 034 6 ± 0.000 000 3), confirms within experimental error the theoretical prediction that R(D) = R(H). (auth)

3018

APPROXIMATE ANALYTICAL WAVE FUNCTIONS FOR THE NUCLEAR INDEPENDENT-PARTICLE MODEL. Alex E. S. Green (Florida State Univ., Tallahassee). Phys. Rev. 104, 1617-24(1956) Dec. 15.

The wave functions, normalization constants, and certain important diagonal matrix elements have been calculated for the diffuse boundary potentials previously described. By taking advantage of the variety of well parameter combinations which give rise to the dimensionless potentials and by utilizing a simple perturbation method, one may extend the usefulness of these wave functions to a large variety of potentials, and it should be possible to generate approximate independent-particle-model wave functions for any proton or neutron state in any nuclear species with A > 10. Relative spin-orbit energy coefficients are calculated for a Thomas-type energy. The requirement that large energy discontinuities exist at the magic numbers N = 20, 28, 50, 82, and 126 restricts the spin-orbit term to be about 45 times the Thomas expression. The radii of neutron and proton orbitals are calculated, the latter being obtained after consideration is given to an attractive proton potential which is needed to account for the general trends of proton binding energies.

Radii of neutron and proton distributions are also calculated. It is found that the equivalent uniform radii are $R_n = 1.30A^{1/3}$ and $R_p = 1.24A^{1/3}$ (in units of 10^{-13} cm). These are to be compared with an equivalent nuclear force radius $R_w = 1.38A^{1/3}$. The attractive nuclear anomaly leads one to expect a thin (0-0.4) neutron membrane around nuclei. (auth)

3019

NUCLEON DENSITIES IN A DIFFUSE-BOUNDARY INDEPENDENT-PARTICLE MODEL. Alex E. S. Green, Kiuck Lee, and Richard J. Berkley (Florida State Univ., Tallahassee). Phys. Rev. 104, 1625-9(1956) Dec. 15.

The approximate wave functions developed in a previous study are applied to a survey of the proton and nucleon densities. The proton densities in six representative nuclei (each assumed to be spherically symmetrical) are calculated and compared with densities inferred from the systematics of the Stanford electron scattering experiments. Apart from a small systematic discrepancy in radii which may readily be removed by a slight readjustment of potential parameters, the theoretical and experimentally inferred proton densities are in general conformity. The theoretical densities, however, display a fine structure not present in the smoothed densities which have been used in interpreting the electron scattering experiments. The total theoretical nucleon densities also show a similar but less pronounced fine structure. In the six cases studied, it is found that the nuclear potentials extend significantly beyond the total nucleon densities. A discussion of the possible physical significance of the density-potential differences is given. (auth)

3020

QUANTUM CALCULATION OF COULOMB EXCITATION. M1 AND M1-E2 MIXED TRANSITIONS AND CLASSICAL APPROXIMATION. L. C. Biedenharn (The Rice Inst., Houston, Texas) and R. M. Thaler (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 104, 1643-51(1956) Dec. 15.

Formulas are derived for magnetic-dipole Coulomb excitation, including spin effects. Numerical results are presented graphically. The mixed M1-E2 transitions are similarly discussed, and the simple pure-mixed analysis is shown to apply except for anomalous cases of slight interest. A classical approximation is discussed in detail, and applied to higher multipoles. (auth)

3021

MOMENTUM OF NUCLEONS IN VARIOUS NUCLEI FROM THE HIGH-ENERGY PHOTOEFFECT. A. Wattenberg, A. C. Odian, P. C. Stein, and H. Wilson (Massachusetts Inst. of Technology, Cambridge) and R. Weinstein (Brandeis Univ., Waltham, Mass.). Phys. Rev. 104, 1710-16(1956) Dec. 15.

The previously reported studies of the high-energy photoejection of neutrons and protons showed the basic validity of the "quasi-deuteron" model. Due to the motion of neutrons and protons in a complex nucleus one observes that the kinematics of the "quasi-deuteron" disintegration are modified from those of the photodisintegration of a free deuteron at rest. The modification of the kinematics was measured for Li, C, O, Al, and Cu in an attempt to compare the "average" momentum of the nucleons in these nuclei. It is found that a Fermi momentum distribution (with T = 0°) does not fit the observed data. A calculation employing only conservation of momentum and assuming a three-dimensional Gaussian momentum distribution for the neutrons and protons, gives an expression that fits the data quite well for Li, C, and O. The 1/e values of the Gaussians for Li, C, and O, respectively are 8, 19, and 19 Mev. These values have been corrected for the experimental angular resolution and for refraction at the nuclear surface. (auth)

3022

NEGATIVE-PION ACTIVATION OF SILVER. W. Goishi and W. F. Libby (Univ. of Chicago, Ill.). Phys. Rev. 104, 1717(1956) Dec. 15.

The yields of some isotopes of palladium, rhodium, and ruthenium produced by the reaction of π^- mesons with silver were determined radiochemically. These results, together with those from a similar study with bromine, make possible a comparison with the data obtained with photographic plates. The results are consistent with each other within the uncertainties of the experimental data. (auth)

3023

PHOTODISINTEGRATION OF DEUTERONS AT HIGH ENERGIES. Dwight R. Dixon and Kenneth C. Bandtel (Univ. of California, Berkeley). Phys. Rev. 104, 1730-6(1956) Dec. 15.

Photodisintegration of deuterons has been investigated by use of the photon beam from the 342-Mev synchrotron at Berkeley. A liquid deuterium target was used. Protons were detected with a telescope consisting of either twelve or thirteen scintillation counters. The height of the pulse from one of the first counters and the number of subsequent pulses served to identify the protons and determine their energy. Differential cross sections were determined at laboratory angles of 36°, 49°, 75°, 106°, and 141° and at energies ranging from 136 Mev to 293 Mev, and curves of the form $d\sigma/d\Omega' = A + B\cos\theta' + C\cos^2\theta'$ were fitted to the experimental points at various energies. Total cross sections in the region of 70 μb were obtained. A comparison with the results of similar experiments at other laboratories indicates that beam monitoring is within 10% agreement in absolute value between the Berkeley synchrotron and other synchrotrons. A method is described for experimentally measuring the nuclear attenuation correction inherent in range counters, rather than calculating the correction. (auth)

3024

PION EFFECTS ON FERMI INTERACTIONS. Marc Ross (Indiana Univ., Bloomington). Phys. Rev. 104, 1736-41 (1956) Dec. 15.

Fermi interactions are examined from the standpoint that the interaction between bare nucleons and light fermions may have simple form. The relation of this proposal to the usual expression of Fermi interactions in terms of physical nucleons is evaluated. This relation is specified fairly definitely by current meson theories for allowed β-decay processes. The possibility of a simple universal Fermi interaction and the relation of associated allowed and forbidden β-decay matrix elements are examined. Although some interesting conclusions can be drawn in these cases, the effects do not appear observable at the present time. (auth)

3025

INTERACTION OF P- AND S-WAVE PIONS WITH FIXED NUCLEONS. Hironari Miyazawa (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev. 104, 1741-6(1956) Dec. 15.

A method is given of replacing pion scattering parts in a Feynman diagram by experimentally observed quantities. In this paper momenta of nucleons are neglected, although nucleon pair creation is not. It is assumed that only P- and S-wave pions interact with nucleons. No interaction is assumed between pions. Two examples are given. The anomalous magnetic moment of the proton is rigorously expressed in terms of pion-nucleon scattering amplitudes, or, alternatively, in terms of the renormalized coupling constant and the total cross sections for pions. The internucleon potential is also expressed by means of scattering quantities. In this case the number of virtual pions ex-

changed between the two nucleons is limited to two, although the number of pions emitted and absorbed by the same nucleon is not limited. (auth)

3026

CONSTRUCTION OF THE ADIABATIC NUCLEAR POTENTIAL: FORMALISM. Abraham Klein (Univ. of Pennsylvania, Philadelphia) and B. H. McCormick (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 104, 1747-57 (1956) Dec. 15.

A new formalism is presented for the construction of the two-nucleon potential, whose salient characteristic is that it involves an expansion only in the number of mesons exchanged, the self-mesonic field of each nucleon being treated, in principle, exactly. Access to the potential is achieved through the intermediary of the scattering matrix. With the assumption that nonlinear meson propagation may be neglected, alternative versions of this matrix are derived, only one of which is exploited in this paper. The connection between the scattering matrix and the potential is discussed, and it is emphasized again that the transition between the two requires a knowledge of non-energy-conserving matrix elements of the potential, which can be obtained only if the underlying Schrödinger equation is known. The potential involving the exchange of at most two P-wave mesons is computed and shown to depend on the renormalized coupling constant, the single-nucleon source function, and the total cross sections for pion-nucleon interaction. The numerical evaluation of these formulas is not here attempted. (auth)

NUCLEAR PROPERTIES

3027 KAPL-1643

Knolls Atomic Power Lab., Schenectady, N. Y.

CALCULATION OF FAST AND THERMAL GROUP CONSTANTS WITH APPLICATIONS TO DIPHENYL. M. C. Conerty, M. L. Storm, C. D. Petrie, and P. F. Zweifel. Oct. 29, 1956. 41p. Contract W-31-109-Eng-52. $0.30 (OTS).

Fast and thermal diffusion lengths and diffusion coefficients are computed for $C_{12}H_{10}$ (diphenyl). Comparison is made with measurements at 185°F, of the thermal diffusion length and of the neutron age to indium resonance. Good agreement between calculation and experiment is obtained for the thermal diffusion length. However, the present status of age calculations for diphenyl is comparable to that for water where the Selengut-Goertzel approach yields better agreement with experiment than the rigorous P_1 approach. Series expansions for extending thermal averages of the diphenyl diffusion length to the case of diphenyl mixtures are presented. A semi-empirical approach is used to obtain the age for diphenyl mixtures. This procedure is normalized to the experimental age in diphenyl. Finally, various methods of calculating fast diffusion coefficients are compared. (auth)

3028 ORO-158

Vanderbilt Univ., Nashville.

FINAL REPORT. Dept. of Physics and Astronomy. Cyril D. Curtis. Aug. 1956. (Includes papers: A RANGER STUDY OF THE Po–Be NEUTRON SPECTRUM. H[erbert] L. Gursky, B[arbara J.] Winnemore, and D[onald] A. Cowan; and A FURTHER STUDY OF THE Po–Be NEUTRON SPECTRUM. B[arbara] J. Winnemore, H[erbert L.] Gursky, D[onald] A. Cowan, and C[yril] D. Curtis; and A STUDY OF THE Po–Be NEUTRON SPECTRUM. Herbert [L.] Gursky, Donald [A.] Cowan, and Barbara [J.] Winnemore; and POLONIUM ALPHA PARTICLE ABSORPTION IN POLYMERS OF POLYCHLOROTRIFLUOROETHYLENE (thesis). Barbara [J.] Winnemore. June 1953.) 111p. Ranger Project Contract AT(40-1)-1340. $18.30(ph OTS); $6.00(mf OTS).

3029

NUCLEAR QUADRUPOLE RESONANCES OF Cl^{35} AND Br^{79} IN SOME HETEROCYCLIC COMPOUNDS. S. L. Segel and R. G. Barnes (Univ. of Delaware, Newark) and P. J. Bray (Brown Univ., Providence, R. I.). J. Chem. Phys. 25, 1286-7(1956) Dec.

3030

FLUORESCENCE YIELD OF THE K SHELL. SPECTROMETRIC MEASUREMENTS ON Tc^{99*}(6.04h) AND In^{115*} (4.5h). Jeanne Laberrigue-Frolow and Pieree Radvanyi. J. Phys. Radium 17, 944-9(1956) Nov.

A β spectrometer was used to study the K Auger and K conversion electrons from isomeric transitions of Tc^{99*} and In^{115*} in order to determine the K fluorescence yield of these two elements. The values obtained are: for Tc, $R_k = 0.70 \pm 0.03$ and for In $R_k = 0.87 \pm 0.03$; the relative intensities of the Auger K-LL, L-LX and K-XY rays are respectively: 1:0.48:0.05 for Tc and 1:0.42:0.05 for In. (tr-auth)

3031

ĈERENKOV RADIATION OF NEUTRAL PARTICLES WITH A MAGNETIC MOMENT. N. L. Balazes (Univ. of Chicago, Ill.). Phys. Rev. 104, 1220-2(1956) Dec. 1.

A simple expression is deduced for the Cherenkov radiation caused by magnetic and electric dipoles. The effect is very small. In the visible spectrum for a fast neutron, the energy loss per unit path per unit frequency range is about 10^{-15} times that of a fast electron. The expression for the energy loss does not contain explicitly the mass of the moving particle. Consequently, this method cannot be used to try to detect whether or not the neutrino has any trace of a magnetic moment. (auth)

3032

SCATTERING OF 7.5-MEV PROTONS BY HELIUM. T. M. Putnam, J. E. Brolley, Jr., and Louis Rosen (Los Alamos Scientific Lab., New Mexico). Phys. Rev. 104, 1303-6 (1956) Dec. 1.

The differential cross section for the elastic scattering of 7.5 ± 0.1 Mev protons from He has been measured at 2.5° intervals over the laboratory angular range 10° to 172.5° using the Los Alamos nuclear plate camera. The results obtained have an absolute standard error of ±2.5% to ±3%. A phase-shift analysis of the data gives for the S, P, and D phase shifts: $\delta_0 = -57.95°$, $\delta_1^+ = 112.1°$, $\delta_1^- = 52.51°$, $\delta_2^+ = 0.44°$, $\delta_2^- = -1.87°$. These results fit the experimental data with a root-mean-square deviation of 2.7% and appear to be in harmony with those determined from experiments at other energies. (auth)

3033

NEW ISOTOPE EINSTEINIUM-248. A. Chetham-Strode and L. W. Holm (Univ. of California, Berkeley). Phys. Rev. 104, 1314(1956) Dec. 1.

The new isotope E^{248} has been identified among the products of the deuteron bombardment of Cf^{249}. It decays principally by electron capture with a half life of 25 ± 5 minutes and also by the emission of (6.87 ± 0.02)-Mev alpha particles. A branching ratio (E.C./α) of ~400 was determined from the amount of Cf^{248} formed by electron-capture decay of the new isotope. Partial excitation functions supporting the assignment to mass number 248 are presented. (auth)

3034

NEW ISOTOPES OF EINSTEINIUM. Bernard G. Harvey, Alfred Chetham-Strode, Jr., Albert Ghiorso, Gregory R. Choppin, and Stanley G. Thompson (Univ. of California, Berkeley). Phys. Rev. 104, 1315-19(1956) Dec. 1.

The new isotopes E^{249}, E^{250}, E^{251}, and E^{252} were produced

by bombardment of Bk^{249} with helium ions. A recoil method was used to separate the bombardment products from the target material, so that the target could be used repeatedly. Approximate excitation functions for the formation of the einsteinium isotopes were measured as well as their half lifes, α-particle energies, and electron-capture branching ratios. (auth)

3035

INTERACTION OF 1.0-, 1.77-, 2.5-, 3.25-, and 7.0-MEV NEUTRONS WITH NUCLEI. J. R. Beyster, M. Walt, and E. W. Salmi (Los Alamos Scientific Lab., New Mexico). Phys. Rev. 104, 1319-31(1956) Dec. 1.

The differential cross sections for elastic scattering of 2.5-Mev neutrons by Al, Fe, Zr, Sn, Ta, and Bi were measured over the angular range from 15° to 160°. At 7.0 Mev similar measurements were made for Be, C, Al, Fe, Zr, Sn, Ta, and Bi at angles ranging from 12° to 150°. Inelastic collision cross sections were determined by sphere transmission measurements for a number of elements at 1.0-, 1.77-, 2.5-, 3.25-, and 7-Mev neutron energies. By using an optical model of the nucleus, cross sections for elastic scattering and for compound nucleus formation were calculated. With suitable choices of the optical model parameters the calculated cross sections are in reasonable agreement with the experimental values. (auth)

3036

CORRECTIONS TO INTERNAL CONVERSION COEFFICIENTS FOR LOW-Z ELEMENTS. George W. Hinman (Carnegie Inst. of Technology, Pittsburgh). Phys. Rev. 104, 1332-3(1956) Dec. 1.

The internal conversion coefficients for gamma rays depend only on the value of the initial-state wave function at the origin, to a good approximation for light nuclei and high energies where the relativistic approximation of Dancoff and Morrison is valid. Corrections for shielding can be made in this region by using the many calculations available of Hartree-Fock electron wave functions. (auth)

3037

(γ,n) CROSS SECTIONS OF NUCLIDES NEAR NEUTRON NUMBER 50. Paul F. Yergin and Burton P. Fabricand (Univ. of Pennsylvania, Philadelphia). Phys. Rev. 104, 1334-9(1956) Dec. 1.

Measurement of the (γ,n) cross sections of the nuclides Sr^{86}, Sr^{87}, Sr^{88}, Y^{89}, Zr^{92}, together with earlier measurements for the nuclides Zr^{90}, Zr^{91}, and Nb^{93}, show a pronounced narrowing of the giant dipole resonances in the region of neutron number 50, the narrowest resonances being those for the 50-neutron nuclides. Possible confusion of the interpretation of the data due to (γ,2n) and (γ,pn) processes is shown to be inadequate to explain the observed effects, and the narrowing is concluded to be real, in agreement with the prediction of the single-particle model of Wilkinson. The changes in widths are observed to occur entirely on the high-energy sides of the curves, the low-energy sides being remarkably similar for all 8 nuclides. A regularity in the behavior of the peak values of the cross sections is also observed. The (γ,n) threshold of Sr^{86} is observed to be at about 11.5 Mev, in agreement with other reaction data, but in disagreement with an earlier tentative assignment based on neutron yield measurements on natural Sr. (auth)

3038

LOW-LYING T = 0 LEVELS IN P^{30}. L. L. Lee, Jr. and F. P. Mooring (Argonne National Lab., Lemont, Ill.). Phys. Rev. 104, 1342-3(1956) Dec. 1.

The $S^{32}(d,\alpha)P^{30}$ reaction has been studied by magnetic analysis. A ground state Q value of 4.831 ± 0.013 Mev has been measured, with excited states at 0.693, 1.440, and 1.97 Mev excitation. The prominence of the 0.693-Mev level in this reaction indicates that it is probably T = 0, if isotopic spin selection rules may be considered valid. (auth)

3039

ULTRASONIC EXCITATION OF NUCLEAR MAGNETIC ENERGY LEVELS OF Na^{23} IN NaCl. W. G. Proctor and W. A. Robinson (Univ. of Washington, Seattle). Phys. Rev. 104, 1344-52(1956) Dec. 1.

The nuclear magnetic levels of Na^{23} in a single crystal of NaCl placed in a strong magnetic field have been saturated by the pure quadrupole transition Δm = 2, caused by ultrasonic excitation. The observed transition rate has been compared with theoretical expressions to find that the electric field gradient generated at the nuclear site by the lattice distortion is very close to that expected from a simple classical model. Hence the large covalent and antishielding factor required to explain the spin-lattice relaxation time on the basis of the theory of Van Kranendonk is not found. Possible reasons for this discrepancy are discussed. (auth)

3040

SPIN AND MAGNETIC MOMENT OF Mn^{53}. W. Dobrowolski, R. V. Jones, and C. D. Jefferies (Univ. of California, Berkeley). Phys. Rev. 104, 1378-80(1956) Dec. 1.

The microwave paramagnetic resonance hyperfine structure of Mn^{53} has been observed in a powdered sample of $MnCl_2$ diluted with $SrCl_2$ at 3 cm wavelength and 20°K. From the number of hfs lines the nuclear spin is found to be $I(Mn^{53}) = 7/2$; from their spacing relative to those of Mn^{55}, the magnetic moment is found to be $|\mu(Mn^{53})| = 5.050 \pm 0.007$ nuclear magnetons. These results are discussed in relation to the nuclear shell model. (auth)

3041

SPINS OF CESIUM-127, CESIUM-129, AND CESIUM-130. William A. Nierenberg, Howard A. Shugart, Henry B. Silsbee, and Robert J. Sunderland (Univ. of California, Berkeley). Phys. Rev. 104, 1380-1(1956) Dec. 1.

The spins of three neutron-deficient radioactive isotopes of cesium have been measured by atomic beam methods. The results are: for 6-hour Cs^{127}, $I = 1/2$; for 31-hour Cs^{129}, $I = 1/2$; for 30-minute Cs^{130}, I = 1. (auth)

3042

EFFECT OF THE FINITE NUCLEAR SIZE ON INTERNAL CONVERSION. E. L. Church (Frankford Arsenal, Philadelphia) and J. Weneser (Univ. of Illinois, Urbana). Phys. Rev. 104, 1382-6(1956) Dec. 1.

It is shown that the finite nuclear size introduces additional nuclear matrix elements into the expression for the rate of internal-conversion-electron ejection which are distinctly different from that for gamma-ray emission of the same multipole order. To illustrate the effect of these new matrix elements, the correction to the K-conversion coefficient of magnetic-dipole transitions is calculated. It is shown that in cases where the gamma-ray matrix element is attenuated (e.g., l-forbidden M1 transitions and the M1 components in odd-A rotational transitions), the new nuclear matrix elements may lead to appreciable deviations between the experimentally measured K-shell conversion coefficient and the theoretical calculations of Sliv. The conversion coefficients of other electric and magnetic transitions are also affected by the introduction of the new matrix elements, as well as angular-correlation measurements involving the conversion electrons. (auth)

3043

ELASTIC SCATTERING OF PROTONS BY BERYLLIUM. Forrest S. Mozer (California Inst. of Technology, Pasadena). Phys. Rev. 104, 1386-98(1956) Dec. 1.

Fifteen angular distributions and three excitation curves for the reaction $Be^9(p,p)$ have been obtained in the proton energy region between 200 and 3000 kev. Angular distribu-

tions for $Be^9(p,d)$ and $Be^9(p,\alpha)$ at 333 kev were also measured. The elastic scattering data have been analyzed and fitted in terms of the following states in B^{10}; an s-wave $J = 1^-$ state near 330-kev proton bombarding energy; a p-wave $J = 2^+$ state near 980 kev; an s-wave $J = 2^-$ state near 998 kev; a p-wave $J = 0^+$ state near 1084 kev; and an s-wave $J = 2^-$ state near 1330 kev. (auth)

3044

GAMMA RADIATION FROM Co^{56} AND Co^{58}. C. Sharp Cook and F. M. Tomnovec (United States Naval Radiological Defense Lab., San Francisco, California). Phys. Rev. 104, 1407-10(1956) Dec. 1.

The gamma rays following the decay of Co^{56} and Co^{58} have been observed by means of a large NaI(Tl) crystal scintillation spectrometer. Relative intensities of the Co^{56} gamma radiation are presented as well as ratios of orbital electron capture to positron emission for both Co^{56} and Co^{58}. (auth)

3045

ANGULAR MOMENTUM COUPLING AND THE INTERNUCLEON INTERACTION IN THE CALCIUM ISOTOPES. J. B. French (Univ. of Rochester, N. Y.) and B. J. Raz (Univ. of Rochester, N. Y. and Argonne National Lab., Lemont, Ill.). Phys. Rev. 104, 1411-23(1956) Dec. 1.

A partial analysis is made of the results of the Massachusetts Institute of Technology Van de Graaff group on (d,p) reactions leading to the levels of Ca^{41}, Ca^{43}, and Ca^{45}. The results demonstrate that the coupling scheme is rather close to the jj limit; more precisely they give small values for the amplitudes of certain minor components of the wave functions for low-lying odd-parity states (e.g., the $(f_{7/2})^2_0\, p_{3/2}$ component of the lowest $J = 3/2^-$ level in Ca^{43}). The amplitudes determined in this way are used to deduce some features of the effective internucleon interaction. It turns out that the (d,p) amplitudes for the low-lying "multiparticle" states are essentially proportional to a matrix element which vanishes identically for any spin-dependent nucleon-nucleon interaction (of either $\sigma_1 \cdot \sigma_2$, tensor or vector type) and thus we obtain directly an approximate range vs depth relationship for the spin-independent interaction. Finally, an approximate spin-dependent central interaction is determined by considering the level structures. A fairly satisfactory interaction between identical nucleons is found to be $H_{12} \simeq -3[3-\sigma_1 \cdot \sigma_2] \exp(-r^2/r_0^2)$ Mev with $r_0 \sim 2.7 \times 10^{-13}$ cm. The general features of the results are similar to those of Levinson and Ford, who consider level structures and magnetic moments, but the exchange nature of the interaction is different. (auth)

3046

SLOW-NEUTRON RESONANCE SCATTERING IN Ag, Au, AND Ta. R. E. Wood (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 104, 1425-33(1956) Dec. 1.

Slow-neutron resonance scattering measurements by the "bright-line" technique have been used as a supplement to and a check on total cross section measurements. It has thus been possible to obtain a complete and consistent set of resonance parameters for the lowest energy resonances in Ag, Au, and Ta. It was determined that the one-level formula is very well obeyed over wide energy ranges for both the scattering and total cross section data. These resonance parameters are reported in the text with the values for the statistical weight factor, g, of 3/4, 5/8, and 9/16 for Ag^{109}, Au^{197}, and Ta^{181}, respectively. In addition it was determined that the nuclear radii are the same within experimental errors for the nonresonant and resonant spin states for Au and Ta. The results indicate that either the nuclear radii differ by 45% for the two spin states of Ag^{109} or the potential scattering of Ag^{107} is 55% larger than for Ag^{109}. (auth)

3047

NEUTRONS FROM THE PROTON BOMBARDMENT OF P^{31}. A. G. Rubin and G. D. Johnson (Boston Univ., Mass.) and J. B. Reynolds (Princeton Univ., N. J.). Phys. Rev. 104, 1444-5(1956) Dec. 1.

The reaction $P^{31}(p,n)S^{31}$ has been studied at $E_p = 17.2$ Mev. The energy spectrum of the neutrons was determined by means of proton recoil measurements in nuclear emulsions. The mass excess, M−A, of S^{31} was calculated to be -10.04 ± 0.20 Mev. Excited states of S^{31} have been located at 1.15 ± 0.15, 2.28 ± 0.20, 3.35 ± 0.20, 4.51 ± 0.15, 5.94 ± 0.30, and 6.41 ± 0.20 Mev. (auth)

3048

DIFFERENTIAL CROSS SECTIONS FOR THE $Be^9(He^3,p)B^{11}$ REACTION. H. D. Holmgren, M. L. Bullock and W. E. Kunz (Naval Research Lab., Washington, D. C.). Phys. Rev. 104, 1446-50(1956) Dec. 1.

The differential cross sections for four highest energy proton groups from the $Be^9(He^3,p)B^{11}$ reaction have been measured at a bombarding energy of 2.00 Mev over the angular region extending from 5° to 170°. In order to fit these data with Legendre polynomial expansions, it was necessary to include polynomials up to the sixth degree. The coefficients in these expansions are tabulated for each proton group. These results by themselves are not inconsistent with the compound nucleus model of nuclear reactions, but when viewed in connection with other results, they indicate the possibility that direct interactions may play an important part in He^3-induced reactions. (auth)

3049

REACTION $N^{14}(p,p'\gamma)N^{14}$. J. K. Bair, H. O. Cohn, J. D. Kington, and H. B. Willard (Oak Ridge National Lab., Tenn.). Phys. Rev. 104, 1595-7(1956) Dec. 15.

The yield of the 2.31-Mev γ rays resulting from the inelastic scattering of protons by N^{14} leaving the residual nucleus in its first excited state, has been measured for bombarding energies ranging from 2.5 to 5.1 Mev. Four levels were found at energies of excitation in the compound nucleus O^{15} of 11.00, 11.08, 11.83, and 11.91 Mev, having experimental widths of 90, 25, 80, and 70 kev, respectively. Angular distributions of the γ rays taken at the resonances were isotropic, in agreement with the previous assignment of spin 0 to the 2.31-Mev state in N^{14}. (auth)

3050

LIFETIMES OF THE FIRST EXCITED STATES OF B^{10} AND Al^{28}. J. C. Severiens and S. S. Hanna (The Johns Hopkins Univ., Baltimore, Md.). Phys. Rev. 104, 1612-16(1956) Dec. 15.

The lifetimes of the first excited states of B^{10} and Al^{28} have been measured by a recoil technique which incorporates coincidence counting. Recoil nuclei are produced in a unique manner which facilitates an accurate determination of the recoil velocity. Corrections to the velocity for target thickness were investigated experimentally. Lifetimes of $(8.5 \pm 2.0) \times 10^{-10}$ sec and $(3.0 \pm 0.5) \times 10^{-9}$ sec were obtained for the first excited states of B^{10} and Al^{28}, respectively. (auth)

3051

HALF-LIFE OF Th^{232} AND THE BRANCHING RATIO OF Bi^{212}. F. E. Senftle and T. A. Farley (U. S. Geological Survey, Washington) and N. Lazar (Oak Ridge National Lab., Tenn.). Phys. Rev. 104, 1629-32(1956) Dec. 15.

The half life of Th^{232} has been calculated by determining an absolute gamma-disintegration rate for Tl^{208} in equilibrium with Th^{232} for three old thorium nitrate salts and one natural thorite sample. The branching ratio, $\alpha/(\alpha+\beta)$, for Bi^{212}, a necessary parameter in the calculation, was also measured. The half life of Th^{232} was found to be 1.42×10^{10} years within an estimated error of 5%, which is essentially

in agreement with the presently accepted value. The branching ratio, $\alpha/(\alpha+\beta)$, of Bi^{212} was found to be 0.362 ± 0.006, about 7.4% higher than the currently accepted value. (auth)

3052

FISSION CROSS SECTIONS OF THE URANIUM ISOTOPES, 233, 234, 236, AND 238, FOR FAST NEUTRONS. R. W. Lamphere (Oak Ridge National Lab., Tenn.). Phys. Rev. 104, 1654-60(1956) Dec. 15.

Fission cross sections of the uranium isotopes, 233 and 238, have been measured from 5 and 500 kev, respectively, to 3-Mev neutron energy. Results of similar measurements to 4 Mev for U^{234} and U^{236} are included. Neutrons were produced by use of a beam of monoenergetic protons from a Van de Graaff generator impinging upon a tritium gas target, for all work except the low-energy end of the U^{233} curve, where the $Li^7(p,n)Be^7$, and $V^{51}(p,n)Cr^{51}$ reactions were employed. A U^{235} fission foil was used to measure neutron flux. Measured quantities were the ratios of the fission cross sections of other isotopes to that of U^{235}, and these ratios are believed to be accurate to about 2%. Ratios were interpreted by use of the currently-accepted curve for fission cross section of U^{235} as presented in the neutron cross section compilation BNL-325. The U^{233} cross section decreases monotonically with increasing energy except for a small rise around 200 kev, and a broad maximum around 2.1 Mev. The U^{238} curve shows a long tail extending down to 0.500 Mev, as contrasted with U^{236} which drops sharply near threshold. This tail shows two plateaus at 1.2 and 1.0 Mev and one perhaps at 0.65 Mev. The cross section rises to 0.59 barn at 3 Mev. (auth)

3053

COMPOUND STATES OF THE SYSTEM Ni^{58} + P. J. P. Schiffer, M. S. Moore, and C. M. Class (The Rice Inst., Houston, Texas). Phys. Rev. 104, 1661-6(1956) Dec. 15.

A Ni^{58} target was bombarded by protons from 2 to 5 Mev in energy. Approximately 70 resonances were observed in the yield of the γ radiation due to inelastic scattering from the state at 1.45 Mev. Angular distributions were obtained for this radiation at 37 resonances. Nineteen of the distributions are consistent with a $5/2^+$ assignment and seventeen fit a $3/2$ assignment, while one distribution was isotropic. All the resonances observed had a width no greater than the target thickness of 4 kev. Absolute yields for the reaction have been determined. The level spacing for states formed by d-wave protons was found to be approximately 30 kev in the region studied. An estimate of the value of $(\gamma^2)_{Av}/\bar{D}$ for these resonances gives 1.4×10^{-14} cm. In order to determine the energies of excitation in Cu^{59}, to which these resonances would correspond, the end point of the Cu^{59} beta spectrum was measured, and found to be 3.75 ± 0.1 Mev. This puts the range of excitation for the resonances observed between 6.3 and 7.9 Mev. (auth)

3054

DECAY SCHEME OF Pt^{199}. J. M. LeBlanc, J. M. Cork, and S. B. Burson (Argonne National Lab., Lemont, Ill.). Phys. Rev. 104, 1670-3(1956) Dec. 15.

The radiations of the 30-min activity of Pt^{199} have been investigated with 180° magnetic photographic spectrometers and a 10-channel coincidence scintillation spectrometer. This activity of platinum has been found to decay by the emission of four beta rays with maximum energies of 0.8, 1.1, 1.3, and 1.7 Mev. Gamma rays with energies of 0.074, 0.197, 0.246, 0.318, 0.475, 0.54, 0.71, 0.79, and 0.96 Mev were detected. Extensive beta-gamma and gamma-gamma coincidence measurements were made; and an energy level scheme is proposed which is consistent with the results of all of the experiments. (auth)

3055

ENERGY LEVELS OF O^{18} AND F^{21}. Nelson Jarmie (Los Alamos Scientific Lab., N. Mex.). Phys. Rev. 104, 1683-7 (1956) Dec. 15.

The reactions $F^{19}(t,\alpha)O^{18}$ and $F^{19}(t,p)F^{21}$ have been studied, yielding the following results; the energy levels of O^{18} up to 6.8 Mev are 1.989, 3.504, 3.929, 5.007, 5.170, 5.311, 5.456, 6.190, and 6.328 Mev. The energy levels of F^{21} up to 2.14 Mev are 0.269, 1.087, 1.694, and 2.036 Mev. The mass defect of F^{21} is measured to be 6.195 Mev, giving a mass of 21.006653 atomic mass units. The yields and cross sections of the levels are studied. These results are compared with data obtained elsewhere and the isobaric systems of mass 18 and 21 are discussed. (auth)

3056

PROTON STRUCTURE AND THE HYPERFINE SHIFT IN HYDROGEN. A. C. Zemach (Massachusetts Inst. of Technology, Cambridge). Phys. Rev. 104, 1771-81(1956) Dec. 15.

The effect of the electromagnetic structure of the proton upon the hyperfine splitting of s states in hydrogen is determined without recourse to any specialized model for proton interactions. The principal modification of the Fermi formula, derivable nonrelativistically, appears as a multiplicative correction $1-2a_0^{-1}(r)_{em}$ where a_0 is the Bohr radius and $(r)_{em}$ is the first statistical moment of a distribution which characterizes the proton structure. The absence of additional structure corrections of experimental consequence is rigorously demonstrated. The method relies on a phenomenological representation of the proton deduced from the invariance principles of quantum field theory. The size of the proton is estimated from the available bound state data and compared with the size prediction inferred from scattering experiments. (auth)

3057

THE RADIOACTIVE DECAY OF ^{57}Ni. J. Konijn, B. Van Nooijen, P. Mostert, and P. M. Endt (Laboratorium voor technische Fysica, Delft, Nederland). Physica 22, 887-97 (1956) Oct.

The radioactive decay of 36 h Ni^{57} has been investigated. With a NaI scintillation spectrometer four γ rays have been found: γ_1 : 0.127 Mev (30 ± 4); γ_2 : 0.40 ± 0.02 Mev (5.5 ± 3); 0.511 Mev (100); γ_3 : 1.363 ± 0.006 Mev (88 ± 5); γ_4 : 1.89 ± 0.02 Mev (14 ± 1). Coincidences were observed between γ_1 and γ_3, while the annihilation radiation is coincident with γ_1, γ_3, and γ_4. With a magnetic lens spectrometer three β^+ branches are observed with the following endpoints and relative intensities: β_1^+ : 0.854 ± 0.009 Mev (76 ± 8); β_2^+ : 0.72 ± 0.03 Mev (22 ± 8); β_3^+ : 0.35 ± 0.05 Mev (2 ± 1). The energy, K-conversion coefficient and K/L ratio of γ_1 were measured as: 0.1272 ± 0.0005 Mev, α_K = 0.022 ± 0.006 and K/L = 9 ± 4. The angular correlation between γ_1 and γ_3 was measured as: $W(\theta) = 1 - (0.096 \pm 0.009)\cos^2\theta$. From these data the following spins and parities can be assigned to the three lowest levels in Co^{57}: E_x = 1.363 ± 0.006 Mev ($J = 3/2^-$); E_x = 1.490 ± 0.006 Mev ($J = 1/2^-$), and E_x = 1.89 ± 0.02 Mev ($J = 3/2^-$). The total Ni^{57} decay energy is Q = 3.24 ± 0.01 Mev. (auth)

3058

RESONANCE CAPTURE INTEGRALS. R. L. Macklin and H. S. Pomerance (Oak Ridge National Lab., Tenn.). Prog. Nuclear Energy, Series 1, Phys. Math. 1, 179-89(1956).

In the calculation of thermal neutron reactors, it is convenient to consider the neutrons in two groups: the thermal neutrons in energy equilibrium with the surroundings and the neutrons above thermal energies. It is then important to know the effective cross sections of many nuclei for reaction with neutrons of this group above thermal energies.

The cross section of a nuclide appropriately weighted over the "1/E" neutron spectrum is known as the resonance capture integral. The summary table in this paper includes measurements of about 70 nuclides or elements. They were performed by activation, by fission counting, by pile oscillation, and by transmission with a 4π detector. Where the separate resonances have been well analyzed, the resonance capture integral can be easily computed from the parameters of the individual levels. The value calculated for gold in this way is used as the standard for this compilation. Most of the values in the summary table are determined by comparison with gold, sometimes through the secondary standards, boron and indium. Twenty-five of these measured values are compared with calculations based on resonance parameters; calculations that depend strongly on the energy of the first resonance and the resonance structure of the energy region that has been well studied. The values in the summary table are for dilute materials, about 0.1 mg/cm^2 to 5 mg/cm^2, or 0.0001 to 0.001 inch thick. In addition, a list of "effective integrals," for situations in which the sample distorts the neutron spectrum, is given. For uranium slugs that are one inch in diameter, or for thorium slugs, the infinite dilution value is no longer useful and the effective integral must be used. Similarly, in the partly dilute range, as for instance uranium dioxide where the oxygen is a diluent that can scatter neutrons, effective integrals must be used. In some reactors, or regions of reactors, where the neutron flux is not distributed as 1/E, direct model measurements are required. (auth)

3059

THE β-DISINTEGRATION OF RaD. W. Stanners and M. A. S. Ross (Univ. of Edinburgh). Proc. Phys. Soc. (London), A69, 836-44(1956) Nov.

Electron-sensitive nuclear emulsion impregnated with RaD citrate was used. RaD events associated with β-particles of RaE were studied to determine the total number of developed grains produced in each RaD event. An analysis of the resulting grain-count distribution provides evidence of the occurrence of a ground-state to ground state β-process in RaD with an intensity of 15.5 ± 3.5% of all disintegrations. The total intensity of excitation of the 46.5 kev state of RaE is thus 84.5 ± 3.5% and the intensity of conversion electrons from this state is 81 ± 4%. The last of these values is consistent with the results previously published by Wu, Boehm and Nagel and by Cranberg. (auth)

3060

THE 440 KEV TRANSITION IN ^{23}Na. R. Berenbaum, J. H. Towle, and J. H. Matthews (Imperial College of Science, London). Proc. Phys. Soc. (London), A69, 858-61(1956) Nov.

Measurements of the K shell internal conversion coefficient of the transition and of the angular distribution of γ rays following the reaction Na^{23} (p,p')Na^{23} are described. Taken together these measurements show that the 440 kev level most probably has spin 5/2 and decays mainly by M1 radiation. (W.L.H.)

3061

DIRECTIONAL CORRELATION MEASUREMENTS AND SOME OTHER RELATED INVESTIGATIONS OF EXCITED NUCLEI. Tor Wiedling. Uppsala, Almquist & Wiksells Boktryckeri AB, 1956. 72p.

Directional correlation measurements on gamma cascades in the decay of Lu^{177}, Yb^{175}, Ni^{65}, As^{76}, Re^{188}, and Pb^{202m} are discussed. In order to carry through experiments of this kind it was necessary to choose such problems that the activity could be produced in reactors. As most of the pile irradiations were made abroad, isotopes with long half lives were selected. Large neutron capture cross-sections were also of importance. Simple disintegration schemes are characteristic of all these nuclei with the exception of Re^{188}. This makes them suitable for this kind of investigation with present experimental scintillation techniques. In connection with the correlation measurements some beta spectroscopic measurements were made. The angular correlation apparatus is described in some detail. Diagrams of the electronic instruments are given. Beta spectroscopic as well as directional correlation measurements were made on Lu^{177}. Spectroscopic measurements were made on Ta^{177}. The directional correlation of the 208-kev and 113-kev γ rays in Hf^{177} was studied with sources in the form of solutions of $Lu(NO_3)_3$ and $LuCl_3$, and of crystalline powders of $Lu(NO_3)_3$, $LuCl_3$, and Lu_2O_3. The mixing ratios of the γ lines are discussed in connection with conversion line measurements. The disturbance observed in polycrystalline sources suggests a static electric quadrupole interaction $(eQ/\hbar)(\delta^2V/\delta z^2)$ of 1900 Mc·sec^{-1} for the 113-kev state. The correlation measurements on the 283–113 kev γ cascade in Lu^{175} showed that both transitions are mixed. The mixing ratios are estimated to 4 ± 3% and 17 ± 3%, respectively. No quadrupole interactions have been observed. In connection with the correlation measurements a reinvestigation was made of the γ spectrum in the decay of Ni^{65}. The old disintegration scheme was confirmed. New results were obtained for the multipole orders of the γ transitions. It was found that both the 0.38-Mev and 1.11-Mev lines are mixed. The former probably consists of 99.4% E2 and 0.6% M1 radiation and the latter of 6% M3 and 94% E2. The spins of the first and second excited levels are probably 7/2 and 5/2. Results of correlation measurements on the 1.4–1.2 Mev cascade in Se^{76} are published for the first time. It was found that the correlation function fits the spin sequence 3 → 2 → 0 quite well. The correlation of the 478–155 kev cascade in Os^{188} has been investigated. Sources in the form of rhenium metal and rhenium nitrate have been used. The disturbance observed in dry rhenium nitrate suggests an electric quadrupole interaction of 3200 Mc·sec^{-1}. The 478-kev line consists of about 99.8% E2 and 0.2% M1 radiation. Measurements on the 422–961 kev cascade in Pb^{202m} definitely designate the 1383-kev level as a 4+ state. (auth)

NUCLEAR REACTORS

3062 APEX-277

General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati.

FABRICATION OF TEFLON CRITICAL EXPERIMENT FUEL ELEMENTS. J. L. Swanson and F. H. Welch. Aug. 1956. 16p. Contract AF33(038)-21102 and AT(11-1)-171. $0.20(OTS).

The early development work of Teflon fuel elements and the results of the production run using enriched U_3O_8 are summarized in this report. The results of the sampling procedure for determination of SS factor weight, and the SS Accountability balance for the production are presented. Also the results of the tensile-strength and bending-angle tests on irradiated and control-modified fuel elements are summarized. (auth)

3063 BNL-54

Brookhaven National Lab., Upton, N. Y.

FINAL REPORT ON REACTOR FUEL ELEMENT RESEARCH, DEVELOPMENT, AND PRODUCTION. W. T. Warner, ed. May 1, 1950. Decl. July 11, 1956. 58p. $0.50(OTS).

The material covered includes the development of the finned Al tube, selection and machining of U slugs, canning of the U including design of the cartridge and development

of the completed cartridge, steps in the production process, finned tube specifications, radiation hazard control, an analysis of production efficiency, and a cartridge production cost analysis. (B.J.H.)

3064 CF-56-11-113
Oak Ridge National Lab., Tenn.
HRT PRESSURIZER HEATER TEST. H. A. McLain. Nov. 21, 1956. 9p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

The pressurizer heater was tested under simulated HRT conditions. It was found that of 5.5 kw output at 208 v 1 kw is lost through insulation, and 4.5 kw is delivered to the pressurizer at temperatures below 750°F. (T.R.H.)

3065 CF-56-12-61
Oak Ridge National Lab., Tenn.
RESONANCE EFFECTS IN ONE-REGION THORIUM BREEDER REACTORS. Seymour Jaye. Dec. 10, 1956. 19p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40 (mf OTS).

The critical mass decreased almost linearly with the increasing η_R/η_T whereas the resonance effect and initial breeding ratio increased approximately linearly with increasing η_R/η_T. The resonance effect was found to be more significant than usually estimated ($\epsilon_{23}P_{23} \simeq 1.15$). The critical mass would be 7% greater if the value of $\eta_R/\eta_T \simeq 0.9$ rather than 1.0, in a 7-ft one-region core containing 300 gm/l of Th^{232} and enough U^{233} to be critical; in this comparison, the resonance effect would be 2% less; the initial breeding ratio would be 5% less; and the initial breeding gain would be 50% less. These calculations show a need for more reliable information than presently available concerning the resonance integrals of U^{233} and its variation with U^{233} concentration. (auth)

3066 CF-56-12-65
Oak Ridge National Lab., Tenn.
LABORATORY TEST OF A CORE COOLER FOR ORR LOOP HN-1. R. A. Lorenz and D. T. Jones. Dec. 18, 1956. 18p. Contract [W-7405-eng-26]. $3.30(ph OTS); $2.40(mf OTS).

A mock-up of a proposed cooler for removing gamma heat from the ORR loop core walls was constructed and tested for heat transfer characteristics. This mock-up cooler consisted of ¼-in. stainless steel tubing double (reverse) wrapped around an eight-inch length of two-inch stainless steel pipe and cast in an Al jacket. As compared with the 88-inch long double-wound cooling coil, the 44-inch single-wound coil appeared better for the particular application of removing gamma heat from the core walls. Extension of the data to 4000 watts of heat removal gave a heat transfer coefficient of 240 Btu/hr ft^2 °F for a water flow of 75 cc/min and an air flow of 3.6 scfm. A similar core cooler was constructed and operated on in-pile development loop DV9. A report from D. B. Weaver to H. C. Savage on the results of tests performed with this cooler is included in the appendix. (auth)

3067 CF-56-12-81
Oak Ridge National Lab., Tenn.
RUN SUMMARY OF HRT-CP-7A AND 8. R. H. Winget. Dec. 17, 1956. 7p. Contract [W-7405-eng-26]. $1.80 (ph OTS); $1.80(mf OTS).

In run 7A, 10.1 g of solids were injected into the system and the solids removal rate by the hydroclone followed by sampling every 4 hours for 48 hours. Solids concentrations decreased from a calculated initial value of 0.4 mg/ml to an apparent equilibrium concentration of about 0.003 mg/ml with a half life of about 1.7 hours. Sixty-eight % of a total of 222 g of solids injected was recovered at the conclusion of run CP-8. A total of 10.5 liters of UO_2SO_4 solution containing 74 g of solids (32% of the solids injected) was drained from the chemical plant without difficulty. The concentration factor was 662. (auth)

3068 CF-56-12-109
Oak Ridge National Lab., Tenn.
RUN SUMMARY OF HRT-CP 9. R. H. Winget. Dec. 19, 1956. 5p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

Of a total of 666 g of solids injected in the system during Run No. 9, 377 g (56.5%) was recovered in the hydroclone loop with a total recovery including samples of 75.1%. Although only 106 g of solids were recovered in the initial drain of the underflow pot, two rinses produced an additional 271 g. Each drain was accomplished without difficulty and there were no signs of plugging. The concentration factor was 1130. After an addition of solids, the concentration of solids decreased with an average half period of approximately one hour. (auth)

3069 CF-56-12-110
Oak Ridge National Lab., Tenn.
RUN SUMMARY OF HRT-CP 10. R. H. Winget. Dec. 19, 1956. 5p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

Approximately 1.5 kg of simulated solids were charged to the solids feed loop and the chemical plant at the rate of about 100 g every four hours. At the conclusion of the additions, 12 l of solution containing 781 g of solids were drained without difficulty from the chemical plant. Thus it was satisfactorily demonstrated that several hundred grams of solids could be drained from the chemical plant. This amount, 781 g, is about twice the quantity of solids expected to be collected and drained from one week of HRT operation. The over-all material balance for solids was 83.3% recovery. The concentration factor was 1700. (auth)

3070 CF-56-12-116
Oak Ridge National Lab., Tenn.
IRRADIATION EXPERIMENT ON ALUMINUM FUEL ELEMENT CONTAINING U_3O_8 DISPERSION. R. J. Beaver. Dec. 27, 1956. 6p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

3071 CF-56-12-117
Oak Ridge National Lab., Tenn.
IRRADIATION EXPERIMENT ON ALUMINUM FUEL ELEMENT CONTAINING URANIUM DICARBIDE DISPERSION. R. J. Beaver. Dec. 27, 1956. 6p. Contract [W-7405-eng-26]. $1.80(ph OTS); $1.80(mf OTS).

3072 HW-42665
Hanford Atomic Products Operation, Richland, Wash.
THERMAL STRESSES IN CYLINDRICAL REACTOR FUEL ELEMENTS. K. R. Merckx. Sept. 15, 1956. 29p. Contract W-31-109-Eng-52. $0.25(OTS).

A method of calculating the thermal stresses in cylindrical shapes is developed. The method uses a material model relating strain rate, temperature, strain, and stress. The material model, evaluated for unirradiated U, is used with this method to obtain the buildup and decay of the thermal stresses and strains in a solid U fuel element operating in the temperature ranges of 100 to 350°C and 350 to 600°C during a 25 minute period of increasing power generation and 700 minute period of steady state operation. During the period of increasing power generation, the elastic surface stresses are predicted to relax 60% for the 100 to 350°C example and 48% for the 350 to 600°C example. Further relaxation of 11.5% for the 100 to 350°C case and 40% for the 350 to 600°C case is calculated during the period of steady state power generation. (auth)

3073 IGR-R/R-197

United Kingdom Atomic Energy Authority. Industrial Group H. Q., Risley, Lancs, England.

VARIATIONAL PRINCIPLE OF ONE GROUP DIFFUSION THEORY FOR INHOMOGENEOUS REACTORS. R. T. Ackroyd. Nov. 1956. 6p.

A variational principle is presented which is an extension of that given for inhomogeneous reactors. The extended variational principle can be used as a basis for a Rayleigh-Ritz approximation procedure to give the critical Laplacian and the flux, according to one-group diffusion theory, in an inhomogeneous reactor. (auth)

3074 KAPL-M-WJL-1

Knolls Atomic Power Lab., Schenectady, N. Y.

A METHOD FOR COMPUTING PRESSURE, FRAGMENT VELOCITIES, AND CORE REACTIVITY DURING EXPLOSION OF A REACTOR PRESSURE VESSEL. W. J. Levedahl and R. D. Howerton. Aug. 7, 1956. 34p. Contract W-31-109-Eng-52. $6.30(ph OTS); $3.00(mf OTS).

A method of analytically determining pressures, radii, and velocities of all regions of an exploding reactor is presented. The solution is obtained by numerical integration of differential equations relating pressure, volume, acceleration, and velocity of several concentric shells representing the core, reflector, pressure vessel, shield water, and shield tank. Complex reactors are transformed into equivalent spheres for analysis and results are transformed back to the true configuration. An explosion due to metal–water reaction causes missile velocities only fractionally higher than velocities from an explosion due to fatigue failure at ordinary operating pressures. Shield-fragment velocities may equal or exceed pressure vessel fragment velocities. Core reactivity drops many dollars during the first milliseconds of an explosion, and the amount of metal–water reaction which can occur is limited by this nuclear shutdown. (auth)

3075 MT-240

Atomic Energy of Canada Ltd. Chalk River Project Chalk River, Ont.

CRITICAL LAPLACIAN AND NEUTRON DENSITIES IN NRX PILE. H. H. Clayton. May 18, 1946. Decl. Nov. 29, 1955. 18p. (AECL-376).

The general method of the reduction of the two-group model to an equivalent one-group model is applied to the NRX pile in order to calculate the critical value of the lateral Laplacian. (B.J.H.)

3076 MT-241

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

FATE OF NEUTRONS IN NRX PILE AND PRODUCTION RATES OF 49 AND 23. H. H. Clayton. May 11, 1946. Appendix: FRACTION OF TOTAL NEUTRON CURRENT ENTERING THE REFLECTOR CAPTURED BY THE THORIUM RODS. J. M. G. Fell. 16p. (AECL-377).

Expressions are given for the rate of leakage and death rates of thermal and fast neutrons in the NRX pile. For the case in which the thorium rods absorb 60% of the total neutron current entering the reflector (the thorium in the rods absorbs 53%) these are used to calculate the final fate of 100 thermal neutrons captured by 25 and the resulting production of Pu^{239} and U^{233}. The fate of neutrons in the NRX pile is shown schematically. The estimated rates of production are 0.90 gms of Pu^{239} and 0.056 gms of U^{233} per Mwd. An appendix by J. M. G. Fell gives the calculation of the fraction of T of the total neutron current entering the reflector subsequently captured as thermal neutrons by the thorium rods. (auth)

3077 RM-1814(RAND)

RAND Corp., Santa Monica, Calif.

NOTE ON NEUTRON FLUX-CURRENT BOUNDARY CONDITIONS AT GAPS IN ONE DIMENSIONAL SYSTEMS. George Safonov. Oct. 25, 1956. 5p. (AD-112377).

3078 TID-4562

Division of Reactor Development, AEC.

EXPERIMENTAL POWER AND TEST REACTORS. A TECHNICAL AND PICTORIAL SUMMARY. Nov. 1956. 48p.

Diagrams and photographs of various experimental and test reactors are given. Pertinent technical data on each reactor are summarized. The reactors discussed are the PWR, EBWR, SRE, EBR-1, EBR-2, HRE-1, HRE-2, OMRE, LMFRE, LAMPRE, MTR, ETR, and SPERT. (B.J.H.)

3079 WAPD-RD-22

Westinghouse Electric Corp. Atomic Power Div., Pittsburgh.

OUTLINE OF PWR REACTOR VESSEL TESTING PROGRAM. P. A. Halpine. Apr. 2, 1955. 5p. Contract AT-11-1-GEN-14. $1.80(ph OTS); $1.80(mf OTS).

3080 WAPD-SFR-S-86

[Westinghouse Electric Corp. Bettis Plant, Pittsburgh]. SSN 578 COOLANT PURIFICATION SYSTEM; DESIGN DESCRIPTION. W. [J.] Singley. Sept. 25, 1956. 29p. Contract NObs-66541.

With this is bound, with separate paging: SSN 579 COOLANT PURIFICATION SYSTEM; DESIGN DESCRIPTION. W. J. Singley. Sept. 25, 1956. 29p. Contract NObs-67500. (WAPD-SFR-S-881).

Included are descriptions of the system requirements, detailed descriptions of the equipment, components, piping, instruments, controls, and protective devices, the principles of operation, and the safety precautions used. (B.J.H.)

3081

FUEL COSTS IN HOMOGENEOUS REACTORS ARE INSENSITIVE TO NUCLEAR PARAMETERS. Melvin Tobias and H. C. Claiborne (Reactor Experimental Engineering Div., Oak Ridge National Lab., Tenn.). Nucleonics 14, No. 12, 52-3, and 56-7(1956) Dec.

This survey covered the effects of geometical and some operational variables on the economics and characteristics of one- and two-region spherical, Th breeder reactors. (W.L.H.)

3082

DECAY-HEAT COOLING REQUIREMENTS OF SPENT FUEL FROM EBR-2. C. H. Scheibelhut (Reactor Engineering Div., Argonne National Lab., Lemont, Ill.). Nucleonics 14, No. 12, 57-60, 62(1956) Dec.

Fuel elements will be removed from the EBR-2 reactor after they have served for three months and have achieved 2% burnup. After being removed from the core they will be stored 15 days in the reactor Na so that the initially intense heat from fission-product decay can be removed. Then the fuel subassembly will be transferred to a cell where the irradiated fuel will be removed for processing. (W.L.H.)

3083

TABLE OF FRENCH REACTORS. Nucleonics 14, No. 12, R8(1956) Dec.

A table is presented of French reactors listing the start-up data, moderator, coolant, fuel, location, power, cost, and flux. (W.L.H.)

3084

CALDER HALL CONFERENCE. Nucleonics 14, No. 12, S10-S32(1956) Dec.

A detailed cutaway of the Calder Hall Reactor is presented. The initial operation, reactor physics, metallurgical development, heat transfer, blower seals, burst-slug detection, fuel handling, and control rod data are given. (W.L.H.)

NUCLEAR TRANSFORMATION

3085

SEARCH FOR O^{20}. S. Katcoff and J. Hudis (Brookhaven National Lab., Upton, N. Y.). J. Inorg. Nuclear Chem. 3, 253-4(1956) Nov.

An attempt to detect O^{20} prepared by an $(\alpha,2p)$ reaction on O^{18} showed that the half life of O^{20} is not in the range 10 min to 150 yr. (auth)

3086

THE REACTION $O^{16}(n,\alpha)C^{13}$. Kiichi Kimura, Isao Kumabe, Kozo Miyake, Hiroshi Ogata, and Kyoichi Miyasita (Univ. of Kyoto). J. Phys. Soc. Japan 11, 1211-20(1956) Dec.

Using an ionization chamber filled with oxygen, the $O^{16}(n,\alpha)C^{13}$ reaction has been observed. The chamber was irradiated with moderated Li–D fast neutrons with continuous energy spectrum, and the output pulses produced by the reaction were registered and the pulse height distribution was determined. We obtained eighteen resonances corresponding to the excited levels of O^{17} at (9.66), (9.45), (9.21), 9.07, 8.90, 8.75, 8.52, (8.41), 8.27, 8.06, 7.93, 7.75, (7.57), (7.39), (7.28), (7.16), (7.09), and 6.89 Mev. (auth)

3087

(p,d) AND (p,α) REACTIONS IN Be^9. G. Weber, L. W. Davis, and J. B. Marion (California Inst. of Technology, Pasadena). Phys. Rev. 104, 1307-13(1956) Dec. 1.

Excitation curves for the $Be^9(p,d)Be^8$ (ground state) reaction have been measured at observation angles of 15°, 45°, 70°, 90°, 110°, and 135° for proton energies between 0.8 and 3.0 Mev. These curves show pronounced resonance structure and strong interference effects between different levels. About 60 angular distributions and the total cross-section curve were constructed from the 6 differential cross-section curves. The angular distributions are peaked forward, except in the region near 1.6 Mev, where a broad resonance, interfering with nonresonant amplitudes, causes the angular distribution to become almost symmetric about 90°. The occurrence of forward peaking at all energies and the good agreement of the angular distribution at 2.84 Mev with a theoretical stripping curve suggest that a pickup process can account for a sizeable fraction of the reaction cross section, even at energies as low as 1 Mev. The total cross section indicates a resonance at 0.93 and weak maxima at 1.25, 1.65, and 2.3 Mev, but not at the T = 1 level at 2.56 Mev. The differential cross section for the $Be^9(p,\alpha)Li^6$ (ground state) reaction was measured at 90° from 0.8 to 3.0 Mev. In addition to the 0.93-Mev peak, this curve shows a pronounced minimum near 1.4 Mev and a weak anomaly at 2.56 ± 0.02 Mev indicating a slight violation of the isotopic spin selection rule. An upper limit of 4×10^{-3} is obtained for the T = 0 impurity of the 2^+, T = 1 state at 8.89 Mev in B^{10}. (auth)

3088

PHOTONEUTRON YIELDS FROM NATURAL MAGNESIUM. Paul F. Yergin (Univ. of Pennsylvania, Philadelphia). Phys. Rev. 104, 1340-2(1956) Dec. 1.

Published measurements of the cross sections for the (γ,n) reaction in natural Mg and in Mg^{25} are in disagreement in the energy region where the other Mg isotopes do not contribute to the cross section of the natural sample, and imply a most unusual cross-section curve for the Mg^{26} isotope at slightly higher energies. A new measurement of the cross section for natural Mg is reported which disagrees strongly with the published data, but agrees with the Mg^{25} values, and implies a not-surprising cross-section curve for Mg^{26}. The origin of the disagreement in the natural-sample cross-section values is unknown. (auth)

3089

SLOW-NEUTRON CAPTURE GAMMA RAYS FROM SODIUM AND CADMIUM. Henry T. Motz (Brookhaven National Lab., Upton, N. Y.). Phys. Rev. 104, 1353-64 (1956) Dec. 1.

A thin-lens magnetic spectrometer has been used to observe the external conversion spectra of $Na^{23}(n,\gamma)Na^{24}$ and $Cd^{113}(n,\gamma)Cd^{114}$ and the internal conversion spectrum of $Cd^{113}(n,\gamma)Cd^{114}$ in the energy range of 300 kev to 3 Mev. An arrangement using an external neutron beam and one using a source located inside the reactor are compared. It is shown that target materials placed inside the reactor allow a better discrimination against background and permit the use of a K x-ray-conversion-electron coincidence scheme for photoelectric conversion which greatly simplifies the observed conversion spectrum. Four of the nine gamma rays observed from sodium are assigned to transitions on the basis of the known energy levels from $Na^{23}(d,p)Na^{24}$; the other five are assigned to probable transitions on an energy and intensity basis. The internal conversion spectrum of Cd^{114} has disclosed a 0+ level at 1308 ± 3 kev and the de-excitation of this level by means of E2 transitions to other states in Cd^{114} is also observed. Three other states in Cd^{114} are proposed in addition to the well-known 559-kev (2+) and 1286-kev (4+) states to explain the observed gamma-ray spectrum: 1212 ± 3 kev (2+ or 1+), 1368 ± 4 kev (2+ or 1+), and 1860 + 5 kev (4+ or 3+). (auth)

3090

STUDY OF THE $Li^6(p,\alpha)He^3$ REACTION. J. B. Marion, G. Weber, and F. S. Mozer (California Inst. of Technology, Pasadena). Phys. Rev. 104, 1402-7(1956) Dec. 1.

The $Li^6(p,\alpha)He^3$ reaction has been studied in the energy range $0.6 \leq E_p \leq 2.9$ Mev by observing the magnetically analyzed He^3 and α particles at laboratory angles of 20° and 60°. By inferring the α yield in the backward direction from the He^3 yield observed at the corresponding forward angle, it was possible to construct the angular distributions of the α particles. Two resonances were found in the energy range studied, corresponding to a low-energy (≈1 Mev) s-wave state and a p-wave state near 1.85 Mev. A single-level resonance formula for a $J = \frac{5}{2}^-$, p-wave state plus a smoothly varying background has been fitted to the total cross-section curve in the region of the 1.85-Mev resonance and the following resonance parameters extracted: $E_\lambda = 2.20$ Mev, $Be^{7*} = 7.80$ Mev, $\theta_p^2 = 0.24$, $\theta_\alpha^2 = 0.048$. A similar analysis was made of the data of Blair and Holland on the mirror reaction, $Li^6(n,\alpha)H^3$, and the following parameters obtained: $E_\lambda = 0.43$ Mev, $Li^{7*} = 7.68$ Mev, $\theta_n^2 = 0.26$, $\theta_\alpha^2 = 0.0085$. The close agreement between the reduced proton and neutron widths obtained from these mirror reactions indicates that the Be^7 level at 7.80 Mev and the Li^7 level at 7.68 Mev are mirror states with $J = \frac{5}{2}^-$. This conclusion agrees with that previously reached by Bashkin and Richards. The α-particle angular distributions in the energy range $0.6 \leq E_p \leq 2.5$ Mev can be qualitatively explained on the basis of two interfering levels with $J = \frac{3}{2}^+$ (at $E_p \cong 1.0$ Mev) and $J = \frac{5}{2}^-$ (at $E_p \cong 1.85$ Mev). The angular distribution of the α particles from the $Li^6(p,\alpha)He^3$ reaction at $E_p = 2.91$ Mev cannot be described in terms of s and p waves alone and suggests either that angular momenta greater than one are becoming effective in the formation of the compound nucleus at the higher bombarding energies or that a direct interaction process is taking place. (auth)

3091

STUDY OF THE $C^{14}(p,n)N^{14}$ AND $C^{14}(\alpha,n)O^{17}$ REACTIONS. Richard M. Sanders (Univ. of Wisconsin, Madison). Phys. Rev. 104, 1434-40(1956) Dec. 1.

Targets of 38.7% carbon 14, deposited from a glow discharge in acetylene, were used for the determination of the following threshold energies: $C^{14}(p,n)N^{14}$, 671.5 ± 0.5 kev; $C^{14}(p,n)N^{14*}$, 3149.6 ± 1.1 kev; $C^{14}(\alpha,n)O^{17}$, 2340 ± 3 kev. Corresponding reaction energies are −626.4 ± 0.5, −2938.3 ± 1.0, and −1820 ± 2 kev. The latter two thresholds were detected by the counter-ratio technique. The $C^{14}(p,n)N^{14}$ excitation curve was extended to 3.4 Mev, covering a resonance at 2908 ± 4 kev with a natural width of 71 ± 5 kev. Resonance energies agree with previous experimental results but the widths are larger, perhaps due to target thickness errors. Absolute cross sections are compared with those of $N^{14}(n,p)C^{14}$. Compound nucleus spins and partial widths are calculated. $C^{14}(\alpha,n)O^{17}$ resonances with energies and natural widths of 2553 ± 4, 1.6 ± 1; 2642 ± 3, 10 ± 1; (2798 ± 11, 22 ± 10)?; 3335 ± 15, 100 ± 20; and 3508 ± 4, 54 ± 3 kev were observed. The 0° differential cross section at 2642 kev is 31 mb/sterad ±60%. An angular distribution taken at this resonance leads to a total cross section of 300 mb and a compound-nucleus spin of either 1^- or 3^-. A method is presented for evaluating resonance width, height, and area to find target thickness and natural width. (auth)

3092

ISOTOPIC-SPIN SELECTION RULE VIOLATION IN THE $O^{16}(d,\alpha)N^{14}$ REACTION. Cornelius P. Browne (Massachusetts Inst. of Technology, Cambridge). Phys. Rev. 104, 1598-1602(1956) Dec. 15.

The $O^{16}(d,\alpha)N^{14}$ reaction has been observed to proceed to the first excited state of N^{14} in violation of the isotopic-spin selection rule. The yields of this alpha group and the alpha groups leading to the ground state and second excited state have been measured from 5.5- to 7.5-Mev bombarding energy. At 7.03 Mev, the angular distributions of the three groups have been measured from 15 to 130 degrees. An absolute cross section has been obtained by comparison with the known proton elastic scattering from O^{16}. The observed isotopic-spin selection rule violation is of the order of magnitude predicted by theory on the basis of Coulomb-force mixing of states of different isotopic spin. (auth)

3093

NEUTRON PRODUCTION BY ELECTRON BOMBARDMENT OF URANIUM. G. C. Baldwin (General Electric Research Lab., Schenectady, N. Y.) and E. R. Gaerttner and M. L. Yeater (Knolls Atomic Power Lab., Schenectady, N. Y.). Phys. Rev. 104, 1652-3(1956) Dec. 15.

A study has been made of the neutron yield from a natural uranium target in the 100-Mev betatron of the General Electric Company. For electron energies above 40 Mev, the neutron output is proportional to electron energy, for constant current in the betatron orbit. At lower energies, with the same current, neutron yield decreases faster than the electron energy. (auth)

3094

ANGULAR CORRELATION FOR THE (a,bγ)-TYPE NUCLEAR REACTION. Alfred A. Kraus, Jr. (The Rice Inst., Houston, Texas and College of Pacific, Stockton, Calif.) and J. P. Schiffer, F. W. Prosser, Jr., and L. C. Biedenharn (The Rice Inst., Houston, Texas). Phys. Rev. 104, 1667-9 (1956) Dec. 15.

The angular correlation for nuclear reactions of the cascade type, (a,bγ), has been calculated. Various specializations are given, and the coherence of interference terms discussed. (auth)

3095

LOW-ENERGY SPECTRA IN THE Be^9 + d REACTIONS. R. W. Gelinas and S. S. Hanna (The Johns Hopkins Univ., Baltimore, Md.). Phys. Rev. 104, 1681-3(1956) Dec. 15.

The Be^9 + d reactions have been studied in the region of the alpha continua arising from many-particle disintegrations. A search was made especially for alpha and triton groups; no evidence was found for a state in Li^7 at 5.5 Mev or for one in Be^8 at 4.1 Mev. (auth)

3096

AMSTERDAM NUCLEAR REACTIONS CONFERENCE HELD JULY 2–7, 1956. Physica 22, 941-1196(1956) Nov.

The major papers read at the Amsterdam Nuclear Reactions Conference are included. The topics discussed include the formation of the compound nucleus, the low-energy nuclear excitation spectrum, the theory of stripping reactions, the optical model for nucleon-nucleus elastic scattering, the Brueckner theory, neutrons and nuclear structure, the analysis of data on nuclear scattering of charged particles, medium energy reactions and scattering, Coulomb excitation, nuclear photodisintegration, capture reactions, experiments on stripping and pick-up reactions, high-energy scattering and polarization, spallation and heavy ion reactions and fission. (B.J.H.)

3097

ON THE REACTION $^{13}C(\alpha,n)^{16}O$. M. G. Rusbridge (Cavendish Lab., Cambridge). Proc. Phys. Soc. (London), A69, 830-5(1956) Nov.

The reaction $C^{13}(\alpha,n)O^{16}$ has been examined from 1.0 to 2.5 Mev bombarding energy. The positions and widths of seven resonances have been measured. Angular distributions have been obtained in five cases, and some tentative spin and parity assignments made. Measurements of the absolute cross section are given and values of reduced neutron and alpha-particle widths have been calculated for three levels in O^{17}. (auth)

3098

THE ANGULAR DISTRIBUTION OF NEUTRONS FROM HIGH ENERGY FISSION. G. N. Harding and F. J. M. Farley (Atomic Energy Research Establishment, Harwell, Berks). Proc. Phys. Soc. (London), A69, 853-7(1956) Nov.

A measurement has been made of the ratio of the numbers of neutrons emitted in directions parallel and perpendicular to the motion of the fission fragments, when fission is induced in natural U by 147-Mev protons. The value obtained, 1.27 ± 0.11, is consistent with the greater part of the neutron emission occurring before fission, the remainder (2.5 ± 1 neutrons) being emitted from the moving fragments, as in thermal fission. (auth)

3099

THE ALPHA ACTIVITY INDUCED IN PLATINUM BY BOMBARDMENT WITH NITROGEN IONS. W. E. Burcham and B. C. Haywood (Univ. of Birmingham, Eng.). Proc. Phys. Soc. (London), A69, 862-5(1956) Nov.

Platinum foils 0.0006 in. thick were bombarded in the internal nitrogen ion beam of the 60-in. Nuffield cyclotron. The beam current was collected, after passage through the foil, by a screened electrode. In this way only ions of energy above 50 Mev were recorded; the upper limit of the continuous distribution of ion energies was about 110 Mev. Beam currents of 10^{-8} to 10^{-9} were used. (W.L.H.)

3100

SPALLATION OF MEDIUM WEIGHT ELEMENTS. Gosta Rudstam. Uppsala, 1956. 168p.

The present investigation deals with the spallation of medium weight elements (mass number between 51 and 75). The cross sections of the spallation products have been

measured for the following spallation reactions: V, Mn, Co, and As irradiated with 170-Mev protons; and As irradiated with 103-Mev and 49-Mev protons. A new technique using small amounts of carriers (0.1 to 0.2 mg) has been used in the cross section determinations. The correction factors, used in converting the counting rate in a GM counter to disintegration rate, have been studied. A mixture of the powdered target element and aluminum (or magnesium) powder has been used in the determination of absolute cross sections (by comparison with the known formation cross section of Na^{24} from Al or Mg). Many half-life determinations have been carried out using the method of least squares. An empirical formula with four parameters has been found, which describes the cross sections of the spallation products, within a factor of about two on the average, for most spallation groups in the mass region in question. A theoretical study of the nucleon cascades developed in the target nucleus by high energy protons has been carried out using a Monte Carlo technique in essentially the same way as was done by Goldberger. The Monte Carlo technique has been used also for a study of the de-excitation of excited nuclei by evaporation of different particles. A combination of the cascade calculation and the evaporation calculation yields the absolute cross sections of the spallation products. These calculated cross sections have been compared with the experimentally determined ones. The agreement is good, which supports the model chosen for the spallation reactions. The cascade-evaporation calculation also gives information about the particles emitted in the reaction, namely, their distributions in angle and energy. (auth)

3101

INVESTIGATION OF THE REACTION $B^{10}(\alpha,p)C^{13}$ BY THE PHOTOGRAPHIC PLATE METHOD. Von A. Papkow (Aus dem Institut fur Physik im Max-Planck-Institut fur Medizinische Forschung, Heidelberg). Z. Naturforsch. 11a, 776-82(1956) Oct. (In German)

PARTICLE ACCELERATORS

3102 AERE-GP/R-2071

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

PHASE STABILITY IN CYCLOTRONS WITH THE FIXED FREQUENCY FIELD LAW. L. B. Mullett. Oct. 1956. 11p.

Two schemes are considered for obtaining phase stability in spiral-ridge cyclotrons without a continuous variation of radio frequency. The first employs an r-f wave travelling outwards from the center of the machine, and shows some similarity to a linear accelerator, while the second has a spatial flutter of magnetic field combined with a periodic time variation of radio frequency so as to achieve an alternating gradient mode of operation. (auth)

3103 AERE-GP/R-2072

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

GAS SCATTERING IN PROTON SYNCHROTRONS. L. B. Mullett. Oct. 1956. 39p.

A review of experimental and theoretical data is made together with new calculations on single scattering loss. Some possible explanations for "minimum aperture" phenomenon, and excessive experimental loss are given. (auth)

3104 AERE-TP/R-2063

Gt. Brit. Atomic Energy Research Establishment, Harwell, Berks, England.

PRELIMINARY DESIGN PARAMETERS FOR THE 6.5 GeV S/R SYNCHROTRON. W. Walkinshaw. Nov. 1956. 22p.

Approximate Lagrangian functions are derived for studying particle dynamics in spiral ridged fields. In this way the Hamiltonian features of the dynamics are retained while considerable simplification in interpretation has been achieved. The application of spiral ridged focusing to conventional synchrotrons is discussed in some detail. The advantages of the machine are weak radial focusing with consequent low momentum compaction, multiple turn injection and transition energy. The vertical focusing on the other hand is increased with a consequent decrease in vertical aperture. (auth)

3105 MURA-2

[Midwestern Universities Research Assn., Urbana, Ill.]

AN ESTIMATE OF EFFECTS OF NON-LINEAR RESTORING FORCES FOR AVOIDING RESONANCES. D. W. Kerst. Aug. 20, 1953. 6p. (MAC-1).

Approximating the restoring forces in an accelerator by thin lenses, an estimate is given of the non-linear forces required to hold the amplitude of betatron oscillations within reasonable bounds with a secularly varying frequency of oscillation. It is found that a cubic force of the order of 20% of the linear force is necessary. The effect of synchrotron oscillations is also discussed. (auth)

3106 MURA-4

Iowa State Univ., Iowa City and [Midwestern Universities Research Assn., Urbana, Ill.]

A PERTURBATION TREATMENT OF NON-LINEAR RESTORING FORCES. F. Cole and F. Rohrlich. Sept. 1, 1953. 7p. (MAC-3).

Two well-known types of perturbation theory are applied to the one-dimensional equations of motion of alternating gradient betatron oscillations. In the first it is shown that the increase of amplitude due to inhomogeneities at integral resonance can be cancelled by the proper choice of the Fourier coefficients of the cubic force. In the second a frequency-amplitude relation is derived. (auth)

3107 MURA-5

Chicago. Univ. and [Midwestern Universities Research Assn., Urbana, Ill.]

ADIABATIC DAMPING OF LARGE PHASE OSCILLATIONS. S. C. Wright. Sept. 2, 1953. 3p. (SCW-1; MAC-4).

The phase oscillation frequency, relative energy, momentum and radial spread are tabulated as functions of the difference in phase from the stable phase φ_s for values of this difference large enough so that the usual linear approximation is not valid. (auth)

3108 MURA-6

[Midwestern Universities Research Assn., Urbana, Ill.].

A STUDY OF THE FEASIBILITY OF A MULTI-BEV CIRCULAR ELECTRON ACCELERATOR. Lawrence W. Jones and [L.] Jackson Laslett. May 9, 1953. 6p. (LWJ-LJL-MAC-5).

Preliminary design figures are given for electron and proton a-g synchrotrons, with a design energy in the 10 Bev range and a repetition frequency 15 to 16 cps. The advantages of these proposed designs are briefly discussed. (auth)

3109 MURA-7

[Midwestern Universities Research Assn., Urbana, Ill.]

MAGNET APERTURE AS A FUNCTION OF n. K. R. Terwilliger. Sept. 4, 1953. 3p. (KMT-MAC-6).

Required magnet aperture as a function of the field index is calculated assuming that oscillation amplitudes are limited by non-linear restoring forces. n is limited by the requirement that a square aperture should fit between the slanting pole pieces necessary to produce the

gradient. Examples show that the n values attainable depend most strongly on tolerance requirements. (auth)

3110 MURA-9
[Midwestern Universities Research Assn., Urbana, Ill.].
CRANIAC MOTION. [NON-LINEAR RESTORING FORCES IN SYNCHROTRONS]. H. R. Crane. Aug. 18, 1953. 2p. (MAC-8).

The possibility of using non-linear restoring forces for controlling the amplitude of betatron oscillations due to field inhomogeneities in accelerators is discussed qualitatively in some detail. It is seen that there is a tendency for the motion to "lock in" and oscillate in frequency about resonant frequencies. The motions of phase and amplitude are discussed as are the possibilities of beam position correction by servo mechanisms. (auth)

3111 MURA-11
[Midwestern Universities Research Assn., Urbana, Ill.].
NON-LINEARITIES IN THE AG SYNCHROTRON. J. L. Powell. Oct. 23, 1953. 5p. (MAC-JLP-1).

The non-linear equations of motion of betatron oscillations in an a–g synchrotron are derived, showing the restrictions imposed by Maxwell's equations. The effect on the equations of motion of the discontinuity in Field gradient at the edge of an a–g magnet is calculated. (auth)

3112 MURA-12
[Midwestern Universities Research Assn., Urbana, Ill.].
THEORY OF ALTERNATING GRADIENT SYNCHROTRON. NOTE ON DISCONTINUITY IN FIELD GRADIENT. J. L. Powell. Nov. 11, 1953. 3p. (MAC-JLP-2).
(For abstract see MURA-11.)

3113 MURA-13
Michigan. Univ., Ann Arbor and [Midwestern Universities Research Assn., Urbana, Ill.].
A NOTE ON THE AMPLITUDE OF BETATRON OSCILLATIONS. Lawrence W. Jones. Nov. 18, 1953. 4p. (MAC-LWJ-1).

The amplitudes of betatron oscillations resulting from injection errors in an A.G. synchrotron are discussed. It is shown that some improvements over earlier schemes may be obtained by proper choice of point of injection. A note is added on the form and effect of non-linear restoring forces. (auth)

3114 MURA-14
Iowa State Coll., Ames. Inst. for Atomic Research and [Midwestern Universities Research Assn., Urbana, Ill.].
DISCUSSION OF SPACE-CHARGE EFFECTS IN THE ALTERNATE-GRADIENT SYNCHROTRON. L. Jackson Laslett. Jan. 1954. 10p. (LJL-MAC-2).

An estimate is made of the charge which can be injected into an a–g synchrotron before space-charge forces become sufficient to move the operating point from the center of a small diamond, bounded by integral and half-integral resonances, half way towards the edge. Numerical examples, for proton a–g synchrotron, are given. (auth)

3115 MURA-16
Illinois. Univ., Urbana.
APPROXIMATE CALCULATION OF NONLINEAR LOCK-IN AT $\sigma = \pi$. D. W. Kerst. Feb. 9, 1954. 6p. (MAC-DWK-4).

By considering energy transfers in regions of positive and negative field index n, an estimate is made of the frequency of oscillations of the "locked-in" (See MURA-9, H. R. Crane) motion at the boundary of the first stability region of the A. G. equations of betatron oscillations (the Meissner equation). Qualitative agreement with digital computer work is found. With field inhomogeneities present, the question of stability of oscillations is discussed by the same methods. (auth)

3116 MURA-17
Illinois. Univ., Urbana.
CHARACTERISTICS OF NON-LINEAR LOCK-IN CAUSED BY FIELD INHOMOGENEITY. D. W. Kerst. Feb. 11, 1954. 5p. (MAC-DWK-5).
(For abstract see MURA-16.)

3117 MURA-18
Iowa State Coll., Ames. Inst. for Atomic Research and [Midwestern Universities Research Assn., Urbana, Ill.].
POSSIBLE INSTABILITY FROM MOMENTUM ERRORS IN THE A. G. S. L. Jackson Laslett. Feb. 1954. 15p. (LJL-MAC-3).

The effective change of the restoring forces resulting from momentum errors in the AGS is examined. The tolerable variation of n, and the corresponding acceptable variation of momentum, are indicated. An example in which the momentum variations are considered to be those resulting from synchrotron oscillations has been carried through, for a proton A. G. synchrotron, with particular attention given to the effect of such momentum errors at injection and at the time the transition energy is reached. (auth)

3118 MURA-19
Iowa State Coll., Ames. Inst. for Atomic Research and [Midwestern Universities Research Assn., Urbana, Ill.].
EQUATIONS OF MOTION IN THE A. G. S.—A REVIEW. L. Jackson Laslett. Apr. 1954. 17p. (LJL-MAC-4).
This report is a re-issue of LJL(ISCAR)-1.
(For abstract see MURA-11.)

3119 MURA-20
[Midwestern Universities Research Assn., Urbana, Ill.]
AN ELECTROMECHANICAL ANALOGUE FOR THE STUDY OF STRONG FOCUSING SYNCHROTRON BETATRON ORBITS. Lawrence W. Jones and Kent M. Terwilliger. Mar. 15, 1954. 6p. (MAC/LWJ/KMT-1).

The design and construction of an electromechanical analogue for the study of A. G. betatron oscillations is described. It consists essentially of an A. C. galvanometer with field coil driven by a square wave to produce strong focusing. The characteristic of a vacuum tube is used to produce the non-linearity. Circuits are described and limitations discussed. Some preliminary results are given. (auth)

3120 MURA-21
[Midwestern Universities Research Assn., Urbana, Ill.].
NON-LINEARITIES IN AG SYNCHROTRON. J. L. Powell. Mar. 30, 1954. 14p. (MAC-JLP-3).

Results are reported of digital computer work with the non-linear equations of motion for betatron oscillations in the a–g synchrotron. The phase points of one-dimensional motions plotted once per sector lie, to the accuracy of the computation, on continuous closed curves in some region surrounding the origin. For larger amplitudes, the motion is unbounded. Variation of frequency and stability limits as functions of amplitude are discussed. Approximate transformations giving displacement and its derivative at the end of one period of the differential equation as a function of the initial conditions are developed. Extensive digital computer work with these transformations is reported, including cases with field inhomogeneities. (auth)

3121 MURA-24
[Midwestern Universities Research Assn., Urbana, Ill.].
REQUISITE ENERGY TOLERANCE AT INJECTION. L. Jackson Laslett. June 21, 1954.

A summary is given of the theoretical basis for estimat-

ing the energy homogeneity desirable in the beam injected into an a–g synchrotron. Some numerical examples are given for proton a–g synchrotrons of 50 Mev injection energy. (auth)

3122 MURA-25

Wayne Univ., Detroit and [Midwestern Universities Research Assn., Urbana, Ill.].

A SMOOTH APPROXIMATION TO THE ALTERNATING GRADIENT ORBIT EQUATIONS. Keith R. Symon. July 1, 1954. 15p. (KRS-MURA-1).

An approximation method for the solution of differential equations with periodic coefficients is developed and applied. The method replaces the periodic coefficients by properly chosen constants and is valid when the betatron wave length is long compared to the sector length. Application is made to one-dimensional equations containing linear and cubic restoring forces. (auth)

3123 MURA-26

Wayne Univ., Detroit and [Midwestern Universities Research Assn., Urbana, Ill.].

SMOOTH SOLUTION TO ONE-DIMENSIONAL AG ORBITS WITH CUBIC FORCES. Keith R. Symon. July 15, 1954. 11p. (KRS-MURA-2).

(For abstract see MURA-25.)

3124 MURA-31

Wayne Univ., Detroit and [Midwestern Universities Research Assn., Urbana, Ill.].

AN ALTERNATIVE DERIVATION OF THE FORMULAS FOR THE SMOOTH APPROXIMATION. Keith R. Symon. Aug. 10, 1954. 14p. (KRS-MURA-4).

(For abstract see MURA-25.)

3125 MURA-32

Wayne Univ., Detroit and [Midwestern Universities Research Assn., Urbana, Ill.].

A STRONG-FOCUSING ACCELERATOR WITH A DC RING MAGNET. Preliminary Report. Keith R. Symon. Aug. 13, 1954. 3p. (int-KRS-MURA-5).

A new type of synchrotron is proposed, having fixed magnetic fields. The large radial gradient enables particles of many different energies to be contained in this field. Vertical focusing is provided by reversed fields and gradients, which given A. G. focusing. Detailed treatments or orbit geometry, linear orbit theory and magnetic field patterns are given, as well as design parameters for a 10 Bev proton synchrotron. (auth)

3126 MURA-35

Argonne National Lab., Lemont, Ill. and [Midwestern Universities Research Assn., Urbana, Ill.].

COUPLING OF BETATRON AND PHASE OSCILLATIONS IN A SYNCHROTRON. E. A. Crosbie and M. Hammermesh. Aug. 1954. 17p. (EAC-MH/MAC-1).

The coupled equations for radial position, momentum and phase oscillations in a synchrotron are treated by use of difference equations. The effect of a radial variation in the accelerating R. F. voltage is included; any resultant damping of one type of oscillation is shown to be necessarily accompanied by equal antidamping of the other type. A simple treatment of the adiabatic variation of parameters for systems of linear differential or difference equations is given. (auth)

3127 MURA-39

Illinois. Univ., Urbana and Midwestern Universities Research Assn., Urbana, Ill.

THE INFLUENCE OF RADIATION ON OSCILLATING ELECTRON ORBITS IN AN IDEAL BETATRON. Nils Vogt-Nilsen. Oct. 1954. 10p. (MURA/NVN/1).

The radiation due to betatron oscillations is discussed. By dropping small terms, it is shown in a special case ($n = \frac{4}{5}$) that the radiating electron will receive an additional damping. (auth)

3128 MURA-41

Midwestern Universities Research Assn., Urbana, Ill.

APPLICATION OF FFAG PRINCIPLE TO BETATRON ACCELERATION. K. M. Terwilliger, L. W. Jones, D. W. Kerst, and K. R. Symon. Nov. 4, 1954. 3p. (MURA-KMT/LWJ/DWK/KRS-1).

It is pointed out that fixed field alternating gradient (FFAG) designs allow a large increase in acceptance time for betatron acceleration. The duty factor of an FFAG betatron might approach 25%. Various applications are briefly discussed. (auth)

3129 MURA-42

Midwestern Universities Research Assn., Urbana, Ill.

A FIXED FIELD-ALTERNATING GRADIENT ACCELERATOR [WITH SPIRALLY RIDGED POLES]. K. R. Symon, D. W. Kerst, L. W. Jones, L. J[ackson] Laslett, and K. M. Terwilliger. [Nov. 12, 1954]. 113p. [(MURA-DWK/KMT/LWJ/KRS-3)].

A new FFAG accelerator is proposed which is intended to overcome the difficulties of large circumference in the alternating field types proposed previously. The radially increasing field gives radial focusing and the vertical focusing is given by a superimposed spiralling field which gives edge focusing effects. Design consideration and approximate parameters are discussed. (auth)

3130 MURA-43

Wayne Univ., Detroit and Midwestern Universities Research Assn., Urbana, Ill.

THE FFAG SYNCHROTRON—MARK I. K. R. Symon. Nov. 12, 1954. 19p. (MURA-KRS-6).

(For abstract see MURA-32.)

3131 MURA-44

Michigan. Univ., Ann Arbor and Midwestern Universities Research Assn., Urbana, Ill.

"PATCH" OPERATION OF A FIXED FIELD ALTERNATING GRADIENT ACCELERATOR, MARK III, WITH COMMENTS ON MOMENTUM COMPACTION AND AMPLITUDES OF OSCILLATION. L. W. Jones. Nov. 12, 1954. 5p. (MURA-LWJ-6)

It is pointed out that the large circumference of the radial sector FFAG accelerator may be avoided by operating in the second stability zone of radial oscillations rather than the first. However, the amplitudes of radial oscillations become very large and the tolerance problems very difficult. It is concluded that this is not a feasible design. The possibility of negative momentum compaction in radial sector FFAG designs is pointed out. (auth)

3132 MURA-45

Midwestern Universities Research Assn., Urbana, Ill.

A FIXED FIELD ALTERNATING GRADIENT SYNCHROTRON WITH A SMALL CIRCUMFERENCE FACTOR. L. W. Jones, D. W. Kerst, L. J. Laslett, K. R. Symon, and K. M. Terwilliger. Nov. 12, 1954. 3p. (MURA-LWJ/DWK/LJL/KRS/KMT-2).

A type of FFAG accelerator is proposed to alleviate the difficulty of large circumference. The edges of magnets are now tapered with respect to radii to produce stronger edge focusing, which increases vertical (radial) stability in positive (negative) momentum compaction machines. An optical analogy in the second report shows that it is difficult to improve the large circumference of the radial sector FFAG accelerator in this way. (auth)

3133 MURA-47(Pts. I and II)

Iowa. State Univ., Iowa City and [Midwestern Universities Research Assn., Urbana, Ill.].

THE STABILITY OF ORBITS IN A NON-LINEAR AG

SYNCHROTRON. PART I. INVARIANT PHASE FUNCTIONS FOR CANONICAL TRANSFORMATIONS. Dec. 19, 1954. PART II. SOME SPECIAL CANONICAL TRANSFORMATIONS IN TWO-DIMENSIONAL PHASE SPACE. [1955]. J. M. Jauch. 50p. (Pt. I (MURA-JMJ-1; SUI-54-11; Pt. II (SUI-55-2)).

The analytic theory of transformations representing the solutions of non-linear differential equations with periodic coefficients is discussed. It is shown that an invariant phase function exists in a formal sense. Further properties of transformations of interest are given. (auth)

3134 MURA-48

Michigan. Univ., Ann Arbor and Midwestern Universities Research Assn., Urbana, Ill.

EDGE EFFECTS AND DETAILS OF CALCULATION OF FFAG MARK II. Lawrence W. Jones. Dec. 10, 1954. (Includes Supplement. Dec. 30, 1954). 15p. (MURA-LWJ-7 and MURA-LWJ-7(Suppl.)).

(For abstract see MURA-45.)

3135 MURA-49

Wisconsin. Univ., Madison and Midwestern Universities Research Assn., Urbana, Ill.

NON-LINEARITIES IN AG SYNCHROTRONS. PART I. A SURVEY OF RESULTS OBTAINED BY USE OF FAST DIGITAL COMPUTER. PART II. APPROXIMATE TRANSFORMATIONS OF THE PHASE PLANE. J. L. Powell and R. S. Wright. Jan. 12, 1955. 39p. (Pt. I (MURA-RW/JLP-4; Pt. II (MURA-RW/JLP-5)).

(For abstract see MURA-21.)

3136 MURA-52

Michigan. Univ., Ann Arbor and Midwestern Universities Research Assn., Urbana, Ill.

FFAG MARK Ib FORMATION INCLUDING EDGES AND STRAIGHT SECTIONS. Lawrence W. Jones and Kent M. Terwilliger. Jan. 24, 1955. 9p. (MURA-LWJ-KMT-2).

It is shown that focusing by magnet edges is important in radial sector FFAG designs, particularly for smaller numbers of sectors. The transformation matrices for edges and for straight sections and the resulting expressions for betatron oscillation frequencies are given. A twenty sector radial FFAG betatron is described, with a circumference factor of four. The production of the required magnetic fields is discussed. (auth)

3137 MURA-53

Michigan. Univ., Ann Arbor and Midwestern Universities Research Assn., Urbana, Ill.

A MARK Ib BETATRON DESIGN. Lawrence W. Jones and Kent M. Terwilliger. Jan. 25, 1955. 7p. (MURA-LWJ-KMT-3).

(For abstract see MURA-52.)

3138 MURA-54

Purdue Univ., Lafayette, Ind. and [Midwestern Universities Research Assn., Urbana, Ill.].

EXPANSIONS WHICH EXPRESS THE MAGNETIC FIELD ON EITHER SIDE OF A PLANE SURFACE IN TERMS OF THE MAGNETIC FIELD ON THE SURFACE, AND THEIR APPLICATION TO THE MARK V, FFAG ACCELERATOR. Edward S. Akeley. Jan. 26, 1955. 13p. (ESA-MURA-1).

The problem is treated of finding expressions for the magnetic field off the median plane of a spiral sector accelerator, given the field on that plane. It is desired that the approximation to the field be Maxwellian and sufficiently simple in form so that the time for digital computation of motion of charged particles in this field will be reasonable. (auth)

3139 MURA-58

[Midwestern Universities Research Assn., Urbana, Ill.].

A SPECIAL CASE OF MARK V PARALLEL SLOPED BARS. Lawrence W. Jones. Apr. 1955. 6p. (MURA-LWJ-8).

Focusing effects of equilibrium orbit oscillations in spiral sector FFAG accelerators are calculated in various approximations. In the first, the magnet poles are separated parallel bars spiralling outward and in the linear approximation, betatron frequencies can be calculated explicitly. In the second, the smooth approximations are used. It is shown in both ways that vertical focusing is increased and radial focusing decreased. In the third, design considerations including the above effect are given for spiral sector cyclotrons. (auth)

3140 MURA-59

[Midwestern Universities Research Assn., Urbana, Ill.].

VERTICAL APERTURE AND FIELD FLUTTER WITH SLOTTED POLE PIECES. K. M. Terwilliger. Feb. 18, 1955. 2p. (MURA/KMT-2).

The optimum field flutter and vertical aperture of the sinusoidal spiral sector FFAG median plane field are calculated in a two dimensional approximation for rectangular and for sinusoidal poles. It is found that for a fixed vertical betatron oscillation frequency there is a broad maximum around one-third or one-fourth for the fractional flutter, in good agreement with digital computer results. Larger flutters require smaller vertical aperture unless pole face windings are used. The ratio of vertical gap to radial separation between ridges is about one-fourth in both cases. The situation is improved when the requirement of sinusoidal median plane field is relaxed. (auth)

3141 MURA-60

Iowa. State Univ., Iowa City and Midwestern Universities Research Assn., Urbana, Ill.

PERTURBATION THEORY OF AG MOTION WITH NON-LINEAR RESTORING FORCES. F. T. Cole. Nov. 20, 1954. 17p. (MURA-FTC-1).

(For abstract see MURA-4.)

3142 MURA-61

Purdue Univ., Lafayette, Ind. and [Midwestern Universities Research Assn., Urbana, Ill.].

A METHOD FOR DETERMINING THE MAGNETIC FIELD IN A REGION IN TERMS OF ITS VALUES ON A PLANE SURFACE. Edward S. Akeley. Feb. 19, 1955. 7p. (ESA-MURA-2).

(For abstract see MURA-54.)

3143 MURA-62

Illinois. Univ., Urbana and Midwestern Universities Research Assn., Urbana, Ill.

HIGH ENERGY FFAG RING MAGNET WITH SPIRALLY RIDGED FIELD. D. W. Kerst. Mar. 2, 1955. 5p. (MURA-DWK-7(Rev.)).

(For abstract see MURA-58.)

3144 MURA-63

Wisconsin. Univ., Madison and Midwestern Universities Research Assn., Urbana, Ill.

CONTRIBUTIONS TO THE UNIFIED THEORY OF FFAG FIELDS. Keith R. Symon. Mar. 17, 1955. 16p. (MURA-KRS-8).

A unified theory of FFAG orbits is developed, assuming a set of equilibrium orbits given. It is shown in general that vertical focusing is enhanced and radial focusing weakened by the oscillations of the equilibrium orbit. (auth)

3145 MURA-64

Illinois. Univ., Urbana and Midwestern Universities Research Assn., Urbana, Ill.

CONSTANT FREQUENCY CYCLOTRONS WITH SPIRALLY RIDGED POLES. D. W. Kerst. Mar. 29, 1955. 10p. (MURA-DWK-9(Rev.)).

(For abstract see MURA-58.)

3146 MURA-65

Michigan. Univ., Ann Arbor and Midwestern Universities Research Assn., Urbana, Ill.

A SPECIAL CASE OF MARK II WITH NO REVERSE FIELD. Lawrence W. Jones. Apr. 30, 1955. 5p. (MURA-LWJ-9).

An FFAG design is discussed with no reversed fields and edge focusing giving the entire vertical focusing. Frequencies of betatron oscillations are derived in the linear approximation. Because $k = (R/H)(dH/dR)$ is small and because frequencies depend so sensitively on edge angle, it is concluded that this is not an attractive design for a high energy synchrotron. (auth)

3147 MURA-66

[Midwestern Universities Research Assn., Urbana, Ill.]

GAP IN A SPIRALLY RIDGED POLE. D. W. Kerst. May 10, 1955. 3p. (MURA/DWK-10)

(See MURA-59 for Abstract.)

3148 MURA-67

Illinois. Univ., Urbana and Midwestern Universities Research Assn., Urbana, Ill.

DETAILED CALCULATIONS OF A SMALL MODEL FFAG MARK Ib ACCELERATOR. PART A. F. T. Cole and D. W. Kerst. May 18, 1955. PART B. F. T. Cole. Aug. 1, 1955. 48p. (PT.A (MURA-FTC/DWK-1); Pt.B (MURA-FTC-2)).

Design, construction, and operation of the Michigan radial sector FFAG betatron are discussed. (auth)

3149 MURA-68

Illinois. Univ., Urbana and Midwestern Universities Research Assn.,Urbana, Ill.

INVESTIGATION OF THE EFFECT OF POSITION OF STRAIGHT SECTIONS WITH APPLICATION TO THE MARK V SPIRALLY RIDGED ACCELERATOR. T. B. Elfe and D. W. Kerst. May 15, 1955. 9p. (MURA-TBE/DWK-1).

The change of betatron oscillation frequencies with radius due to radial straight sections crossing ridges in a spiral sector FFAG accelerator is estimated by matrix methods, and by the smooth approximation. It appears that the change is large enough so that a resonance is crossed in both radial and vertical oscillations. Further calculations show that it is possible to reduce this change somewhat with about three straight sections per sector. (auth)

3150 MURA-69

Indiana. Univ., Bloomington and [Midwestern Universities Research Assn., Urbana, Ill.].

RADIAL AND PHASE MOTION IN A SYNCHROTRON. Norman C. Francis. Oct. 1, 1955. 7p. (MURA/NCF-1).

The adiabatic solution to the coupled linear phase and radial equations of motion is obtained. The solution presented is a good approximation when the momentum gain per turn is small compared with the momentum of the particle. The effect of an accelerating electric field which depends on the radial position is discussed. (auth)

3151 MURA-70

Purdue Univ., Lafayette, Ind. and Midwestern Universities Research Assn., Urbana, Ill.

THE VECTOR POTENTIAL OF THE MAGNETIC FIELD IN THE MARK V ACCELERATOR. Edward S. Akeley. May 28, 1955. 24p. (ESA-MURA-3).

(For abstract see MURA-54.)

3152 MURA-72

Illinois. Univ., Urbana and Midwestern Universities Research Assn., Urbana, Ill.

DISTRIBUTIONS OF STRAIGHT SECTIONS IN MARK V. D. W. Kerst. June 27, 1955. 5p. (MURA-DWK-11).

(For abstract see MURA-68.)

3153 MURA-73

Illinois. Univ., Urbana and Midwestern Universities Research Assn., Urbana, Ill.

A VECTOR POTENTIAL EXPANSION AND THE CORRESPONDING EQUATIONS OF MOTION FOR A MARK V FFAG ACCELERATOR. Nils Vogt-Nilsen. June 1955. 18p. (MURA/NVN/2).

(For abstract see MURA-54.)

3154 MURA-74

Michigan. Univ., Ann Arbor and Midwest[ern] Universities Research Assn., Urbana, Ill.

INJECTION INTO THE MARK Ib FFAG MODEL. Lawrence W. Jones. July 30, 1955. 13p. (MURA-LWJ-10).

(For abstract see MURA-67.)

3155 MURA-75

Iowa State Coll., Ames and Midwestern Universities Research Assn., Urbana, Ill.

CHARACTER OF PARTICLE MOTION IN THE MARK V FFAG ACCELERATOR. L. Jackson Laslett. July 30, 1955. 35p. (LJL-MURA-5).

With this are bound: A sequel "PARTICLE MOTION IN THE MARK V FFAG." Aug. 1, 1955. 9p. and Addendum (MURA-LJL(6)). Aug. 12, 1955. 2p.

Information concerning the nature of particle motion in the spirally ridged FFAG accelerator is derived analytically, with emphasis on the nature of small amplitude oscillations about a scalloped equilibrium orbit. Techniques for further study of the motion by an electronic digital computer are also presented. A diagram of the first stability region is given. (auth)

3156 MURA-76

Ohio State Univ., Columbus and Midwestern Universities Research Assn., Urbana, Ill.

THE CONSTRUCTION OF APPROXIMATE PHASE PLANE TRANSFORMATIONS FOR A. G. SYNCHROTRONS. [PART] I. Andrew M. Sessler. Aug. 2, 1955. [PART] II. Andrew M. Sessler. Aug. 8, 1955. 28p. (MURA-AMS-2; MURA-AMS-3).

The mathematical techniques of Birkhoff are used to derive approximate phase plane transformations for betatron oscillations in an A. G. Synchrotron. The theory is extended to include two-dimensional motion. Considerable attention is given to an example, a conventional A. G. accelerator with one dimensional motion and purely cubic non-linearities. The theory is compared favorably with numerical calculations performed on the Illiac, and it is shown how to use the approximate transformations to calculate such things as the effects of field inhomogeneities. (auth)

3157 MURA-77

California. Univ., Berkeley. Radiation Lab. and Midwestern Universities Research Assn., Urbana, Ill.

ANALYTICAL APPROXIMATION IN MARK V SCALLOPED ORBITS AND TO RADIAL BETATRON OSCILLATIONS ABOUT THEM. David L. Judd. Aug. 10, 1955. 16p. (MURA-DLJ-1).

The expansions of the equations of motion of betatron oscillations in the Mark V (spiral sector) FFAG accelerator in powers of the deviation from a circle and from an equilibrium orbit are discussed. It is found that in the case of large machines where $k \gg 1$ and $1/\omega \gg 1$ that comparatively simple equations for the combined radial and axial motion are quite accurate, while in the case of small machines, where these conditions do not hold, no such simple equations appear to exist. Coefficients in these equations are derived, and their magnitudes estimated and numerical examples given. (auth)

3158 MURA-78

California. Univ., Berkeley. Radiation Lab., and Midwestern Universities Research Assn., Urbana, Ill.

NON-LINEAR TERMS IN MARK V RADIAL BETATRON EQUATION. David L. Judd. Aug. 12, 1955. 8p. (MURA-DLJ-2).

(For abstract see MURA-77.)

3159 MURA-79

Ohio State Univ., Columbus and Midwestern Universities Research Assn., Urbana, Ill.

STUDY OF THE EFFECTS OF DISPLACED SECTORS WITH APPROXIMATE PHASE PLANE TRANSFORMATIONS. Andrew M. Sessler. Aug. 16, 1955. 10p. (AMS-MURA/4).

(For abstract see MURA-76.)

3160 MURA-80

[Midwestern Universities Research Assn., Urbana, Ill.].

MARK V FFAG. EQUATIONS OF MOTION FOR ILLIAC COMPUTATION. J. L. Powell. Aug. 16, 1955. 6p. (MURA-JLP-6).

(For abstract see MURA-54.)

3161 MURA-81

Illinois. Univ., Urbana and Midwestern Universities Research Assn., Urbana, Ill.

THE POSSIBILITY OF HIGH INTENSITIES FROM FFAG ACCELERATORS PROVIDING A MEANS OF INCREASING THE ENERGY. D. W. Kerst. Aug. 26, 1955. 5p. (MURA-DWK/12).

The possibility of colliding beams of particles from two FFAG accelerators as a means of producing high energies is explored. The higher intensity possible with FFAG makes this appear more attractive than with conventional accelerators. Calculations of Coulomb scattering, background, phase space requirements, space charge effects, beam geometry, and kinematics are given. (auth)

3162 MURA-82

Midwestern Universities Research Assn., Urbana, Ill.

DESIGN PARAMETERS FOR AN 8 SECTOR FFAG MARK Ib MODEL. F. T. Cole, R. O. Haxby, L. W. Jones, D. W. Kerst, and K. M. Terwilliger. Aug. 31, 1955. 4p. (MURA-FTC/ROH/LWJ/DWK/KMT-1).

(For abstract see MURA-67.)

3163 MURA-83

Midwestern Universities Research Assn., Urbana, Ill.

THE ELECTROSTATIC FIELD OF THE KICKER ELECTRODES IN THE B. N. L. ELECTRON ANALOGUE. R. Wimpress, R. King, R. Holzman, J. N. Snyder, and L. Jackson Laslett. Sept. 7, 1955. 5p. (MURA-LJL-7).

The electrostatic potentials at points within the quadrupole elements of the Brookhaven Electron Analogue have been solved by the ILLIAC for the case in which these electrodes serve the function of kicker electrodes. With the electrode surfaces represented by $x^2 - y^2 = \pm a^2$, a pair of opposed electrodes maintained at potentials $\pm V_0$ and the remaining pair at ground potential, the central field is found to be $V_0/1.234a$. Numerical values for the potential are listed, together with the first three terms of an approximate harmonic representation of the results. (auth)

3164 MURA-85

Illinois. Univ., Urbana and Midwestern Universities Research Assn., Urbana, Ill.

INVESTIGATIONS OF F-IMPERFECTIONS IN AN ALTERNATING GRADIENT SYNCHROTRON WITH NON-LINEAR FORCES. L. D. Fosdick. Oct. 20, 1955. 26p. (MURA-LDF/1).

Orbit dynamics of an A. G. Synchrotron with non-linear restoring forces and random misalignments have been investigated using transformations to represent approximately the solutions of the equations of motion. The displacement of the equilibrium orbit is found to be small, due to the special type of misalignments considered. For misalignments of r.m.s. deviation less than 10^{-3} in units of the machine radius, the phase plots of the motion are qualitatively similar to those without misalignments, but above this value, the size of the stable region of phase space drops sharply. (auth)

3165 MURA-86

Illinois. Univ., Urbana and Midwestern Universities Research Assn., Urbana, Ill.

THE EFFECTS OF THE STRAIGHT SECTIONS IN MARK V. Tihiro Ohkawa. Nov. 1, 1955. 12p. (MURA-TO-2).

(For abstract see MURA-68.)

3166 MURA-88

Illinois. Univ., Urbana and Midwestern Universities Research Assn., Urbana, Ill.

SOME ESTIMATES OF PROPERTIES OF INTERSECTING BEAM ACCELERATORS. D. W. Kerst. Dec. 3, 1955. 16p. (MURA-DWK/13).

(For abstract see MURA-81.)

3167 MURA-90

Ohio State Univ., Columbus and Midwestern Universities Research Assn., Urbana, Ill.

HALF-SECTOR PHASE PLANE TRANSFORMATIONS FOR AN A. G. SYNCHROTRON. Andrew M. Sessler. Dec. 21, 1955. 5p. (MURA-AMS-5).

(For abstract see MURA-76.)

3168 MURA-101

Michigan. Univ., Ann Arbor and Midwestern Universities Research Assn., Urbana, Ill.

A NOTE ON THE ACCELERATED BEAM OBTAINED IN THE MICHIGAN RADIAL SECTOR FFAG ELECTRON MODEL. Lawrence W. Jones and Kent M. Terwilliger. Mar. 12, 1956. 3p. (MURA-LWJ/KMT-4).

(For abstract see MURA-67.)

3169 MURA-104

Michigan. Univ., Ann Arbor and Midwestern Universities Research Assn., Urbana, Ill.

A SMALL MODEL FIXED FIELD ALTERNATING GRADIENT RADIAL SECTOR ACCELERATOR. Lawrence W. Jones and Kent M. Terwilliger. Apr. 3, 1956. 24p. (MURA-LWJ/KMT-5).

(For abstract see MURA-67.)

3170 MURA-110

Indiana. Univ., Bloomington and Midwestern Universities Research Assn., Urbana, Ill.

INTERSECTING BEAM ACCELERATOR WITH STORAGE RING. D. B. Lichtenberg, R. G. Newton, and M. H. Ross. Apr. 26, 1956. 6p. (MURA-DBL/RGN/MHR-1).

It is proposed that a beam of particles be stored in a ring magnet and used for intersecting beam experiments. Methods of ejection from the accelerator and injection into the storage ring are discussed. (auth)

3171 MURA-126

Midwestern Universities Research Assn., Urbana, Ill.

MODIFICATION OF LIOUVILLE'S THEOREM REQUIRED BY THE PRESENCE OF DISSIPATIVE FORCES. D. B. Lichtenberg, P. Stehle, and K. R. Symon. July 12, 1956. 5p. (MURA-DBL/PS/KRS-1). $1.80(ph OTS); $1.80(mf OTS).

The change in volume of a region of phase space when dissipating forces are present is calculated. Application is made to the problem of decreasing the phase space occupied by particles in a high energy particle storage ring by the use of foils. It is concluded that foil thickness required is

so large that scattering in the foil would cancel the compression in phase space. (auth)

3172 MURA-135

Midwestern Universities Research Assn., Urbana, Ill.

RESULTS OF MISCELLANEOUS TWO-DIMENSIONAL POTENTIAL COMPUTATIONS, INVOLVING POLE-FACE CURRENTS, OF POSSIBLE INTEREST IN FFAG MAGNET DESIGN. L. Jackson Laslett. Aug. 17, 1956. 15p. (MURA-LJL-Internal-1; MURA-LJL-10). $3.30(ph OTS); $2.40(mf OTS).

Computations have been made of the median plane fields which result magnetostatically from various two-dimensional pole configurations resembling those which would be employed in a spiral sector FFAG accelerator. The flutter (the root mean square deviation of the field from its average in units of its average), gap size and circumference factor are tabulated. (auth)

3173 MURA-137

Indiana. Univ., Bloomington and Midwestern Universities Research Assn., Urbana, Ill.

A SIMPLE METHOD FOR RF ACCELERATION IN A FIXED FIELD MACHINE. Don B. Lichtenberg. Sept. 6, 1956. 11p. (MURA-DBL-2). $3.30(ph OTS); $2.40(mf OTS).

Gas scattering, space charge, resonance and oscillator limitation effects on methods of R. F. acceleration in FFAG accelerators are discussed. Two sets of parameters for "intermediate stacking" systems are developed which accelerate particles rapidly through the low energy region where gas scattering is important and do not have resonances between R. F. and betatron oscillation frequencies, thus overcoming the difficulties of earlier schemes. (auth)

3174 MURA-140

Midwestern Universities Research Assn., Urbana, Ill.

BEAM LOADING ON AN R. F. CAVITY AND AN ACCELERATION SCHEME BY VELOCITY MODULATION. Tihiro Ohkawa. Sept. 18, 1956. 9p. (MURA-TO-7). $1.80(ph OTS); $1.80(mf OTS).

Several effects of beam loading on an R. F. cavity are discussed. An acceleration scheme with a non-linear negative resistance and a passive cavity is developed. A second scheme using velocity modulation effects similar to those in klystrons is also developed with two cavities close together. The first method appears to be useful when particle energies are large compared to R. F. voltages and the second when these quantities are comparable. (auth)

3175 MURA-142

[Midwestern Universities Research Assn., Urbana, Ill.]. NECKTIE, BUTTONS, AND PATCH TABLES. [D. W. Kerst]. July 1954. 9p. (MAC-DWK-1)

Cos σ is tabulated as a function of the parameters occurring in a conventional A. G. synchrotron, i.e., one with piecewise constant coefficients. In the first, the parameters are $\psi_1 = \pi\sqrt{|n_1|}/N$ and $\psi_2 = \pi\sqrt{|n_2|}/N$. In the second cos σ and β are tabulated as functions of the same ψ_1 and ψ_2. In the third, cos σ is given as a function of $\psi_1 = \sqrt{|n_1|}\Theta_1$ $\psi_2 = \sqrt{|n_2|}\Theta_2$ and $\zeta = |n_2/n_1|$. These last tables may also be used when arc length is used as independent variable. (auth)

3176 MURA-143

[Midwestern Universities Research Assn., Urbana, Ill.]. NECKTIE TABLES (COMPUTED ON THE UDEC BY THE WAYNE UNIVERSITY COMPUTATION LABORATORY). K. R. Symon. Apr. 1954. 12p.

(For abstract see MURA-142.)

3177 MURA-145

Midwestern Universities Research Assn., Urbana, Ill. and Illinois. Univ., Urbana.

σ_1, σ_2, ψ_1, ψ_2, m_2/m_1, H_2^1/H_1^1 TABLES. J. N. Snyder and D. Hutchinson. Apr. 1954. 29p.

(For abstract see MURA-142.)

3178 MURA-147

Illinois. Univ., Urbana and Midwestern Universities Research Assn., Urbana, Ill.

TABLE PERTAINING TO SOLUTIONS OF A HILL EQUATION. G. Belford, L. Jackson Laslett, and J. N. Snyder. Apr. 3, 1956. 428p.

The digital computer of the University of Illinois has been employed to determine the characteristic exponent and a quantity related to the phase function for solutions of a Hill equation of the form $d^2y/dt^2 + [A + B\cos 2t + C\cos 4t + D\cos 6t]y = 0$ for a series of values of the coefficients with $-0.5 \leq A \leq 0.5$, $-0.5 \leq B \leq +2.0$, $-0.5 \leq C \leq +0.5$, $-0.05 \leq D \leq +0.1$. These tables are available through the unpublished Mathematical Tables File at U.C.L.A. (auth)

3179 ORO-159

Florida. Univ., Gainesville.

FINAL REPORT TO THE ATOMIC ENERGY COMMISSION ON THE VAN DE GRAAFF ACCELERATOR. D. C. Swanson. Aug. 1956. 22p. Contract AT(40-1)-231. $4.80 (ph OTS); $2.70(mf OTS).

The Van de Graaff accelerator built at the University of Florida is described. (T.R.H.)

3180 UCRL-3519

California. Univ., Berkeley. Radiation Lab.

BEVATRON OPERATION AND DEVELOPMENT. X. [Period covered] May, June, July 1956. Walter Hartsough. Nov. 8, 1956. 23p. Contract W-7405-eng-48. $4.80(ph OTS); $2.70(mf OTS).

The absorption of antiprotons in H was measured by use of counters and a liquid hydrogen target. An experiment was begun using a Pb glass Cerenkov counter to observe the annihilation of antineutrons produced from antiprotons by charge exchange in a Be target. Emulsion was exposed to a focused and analyzed antiproton beam for seven groups. The investigation of K-meson production, interaction, and decay was continued by four groups at this laboratory, using counters, emulsions, a 10-inch liquid H bubble chamber, and a propane bubble chamber. Nine emulsion exposures to focused and analyzed K-meson beams were made for seven groups outside this laboratory. The study continued of the π^0 modes of heavy-meson and hyperon decay. The angular distribution of θ^0 meson decay was measured. Twenty-five target bombardments in the internal proton beam were made for the chemistry group. The internal beam-deflection magnet and an energy-loss target were installed in the Bevatron. The number of quadrant-mounted targets for use by the experimental groups was increased from seven to eleven. The new wideband r-f driver was tested. Although it was possible to accelerate a beam to full energy with this unit, modifications to both the new driver and the existing final-amplifier saturating supply will have to be made before satisfactory operation will be obtained. (auth)

3181

LINEAR ELECTRON ACCELERATOR WITH PRELIMINARY COLLECTION. APPLICATION TO ELECTRON DIFFRACTION BETWEEN 0.5 AND 1 MEV. M. Papoular. Ann. Phys. 1, 914-58(1956) Nov.-Dec.

3182

ON THE THEORY OF BETATRON OSCILLATIONS OF PARTICLES IN MAGNETIC SYSTEMS. I. A. A.

Kolomenskiĭ. (Moscow Inst. of Physics). Zhur. Tekh. Fiz. 26, 1969-77(1956) Sept. (In Russian)

Investigations are made of particle motions in a magnetic field in the area arbitrarily taken (in a space) curve. Equations are developed for betatron oscillations and studies are made of some special cases. (R.V.J.)

3183

ON THE THEORY OF BETATRON OSICLLATIONS OF PARTICLES IN MAGNETIC SYSTEMS. II. A. A. Kolomenskiĭ. (Moscow Inst. of Physics). Zhur. Tekh. Fiz. 26, 1978-90(1956) Sept. (In Russian)

A series of perturbation resonance phenomena (linear and non-linear) occurring in magnetic periodic systems were investigated by a single method and in general way can be applied to any periodic system. A special attention was given to the new, strong focusing systems. (R.V.J.)

3184

STEREOBETATRON. V. A. Moskalev (Tomsk Polytechnical Inst.) Zhur. Tekh. Fiz. 26, 2060-1(1956) Sept. (In Russian)

A general description and illustration are given for a 10-Mev betatron with two acceleration chambers. (R.V.J.)

3185

PROCEEDINGS OF THE CERN SYMPOSIUM ON HIGH ENERGY ACCELERATORS AND PION PHYSICS, HELD IN GENEVA, JUNE 11-23, 1956. VOLUME 1. HIGH ENERGY ACCELERATORS. E. Regenstreif, ed. Geneva, European Organization for Nuclear Research, 1956. 567p. Price: 40 Frs. (This publication is composed of several papers by various authors. Most of the papers are in English but a small number are in French.)

Papers given on new accelerating machines include those on accelerator studies at Harwell, fixed field alternating gradient particle accelerators, properties of an intersecting-beam accelerating system, a synchrotron with a double vacuum chamber, the Argonne 12-Bev proton synchrotron, methods of r-f acceleration in fixed field accelerators, the design of an isochronous accelerator with constant betatron frequencies, the design of high-energy accelerators, the storage-ring synchrotron, the relativistic stabilized electron beam, the coherent principle of acceleration of charged particles, the use of plasma waveguides in accelerators, and alternating phase focusing. Discussions on the problems concerning the transition energy include topics such as phase transition in the alternating-gradient accelerator, effects of non-linearities on the phase transition, decay of the passage through the transition energy in accelerators, a proton ring accelerator for 7 Bev, and main characteristics of a strong-focusing 50 to 60 Bev proton accelerator. Discussions on ejection problems include topics such as the external proton beam at the Cosmotron, deflection of the beam of a 7-Bev strong-focusing proton accelerator, ejection problems for the CERN-AG machine, regenerative action in high-energy accelerators, the USSR 6 meter synchrocyclotron, and a synchrocyclotron ejector. Papers on linear accelerators and injection include those on injectors for proton synchrotrons, alternating gradient focusing in linacs, proton orbits in the Brookhaven linear accelerator, computation of drift tube shapes, study of magnetic lenses, a chromatic injector for the Saclay synchrotron, design of high-current linacs, proton linacs, methods of acceleration, a microwave linear accelerator, beam stability and proton injection by molecular dissociation. Theoretical discussions on betatron oscillations include those on non-linear orbit problems in synchrotrons and in the AG synchrotron, a mechanical analog for studying the oscillations, particle orbits in FFAG accelerators, synchrotron resonance lines, and curvature effects in the CERN proton synchrotron. Discussions on magnet problems include topics such as the electromagnet for an AG synchrotron, corrections of magnetic fields, magnetic characteristics of a 10-Bev Australian synchrotron, a small model FFAG radial accelerator, spiral sector magnets, suppression of ripple voltages, electromagnets for a 10-Bev synchrotron, and a ring shaped proton accelerator. R-f acceleration problems are also discussed as are electron synchrotron problems and the use of accelerators. (B J.H.)

RADIATION ABSORPTION AND SCATTERING

3186

MEASUREMENT OF THE ELASTIC SCATTERING OF 2.26-Mev γ RAYS IN LEAD, BISMUTH, AND URANIUM. Philippe Eberhard, Lazare Goldzahl, Eiichi Hara, and Eugene Alexandre. Compt. rend. 243, 1862-5(1956) Dec. 5.

Results are given of measurements of the elastic scattering of ThC'' γ rays at angles from 25 to 125°. The certainty attributed to the values obtained is justified. (B.J.H.)

3187

APPLICATION OF γ BACKSCATTERING TO DENSITY MEASUREMENTS IN SOILS. J. Jacquesson. J. Phys. Radium 17, Suppl. 176A-80A(1956) Nov.

3188

ANALYTICAL REPRESENTATION OF HARTREE POTENTIALS AND ELECTRON SCATTERING. William J. Byatt (Univ. of Alabama, Univ., Alabama). Phys. Rev. 104, 1298-1300(1956) Dec. 1.

Analytical fits to the Hartree curves of 19 neutral atoms are presented. These are in the form of either Wentzel potentials, for lighter elements, or a series of Wentzel-like terms, for heavier elements. Applications to the scattering of electrons by atoms are briefly discussed. Among the principal results is an iteration method which yields expressions, in terms of tabulated integrals, for the radial eigenfunctions for a particle scattered by a Wentzel potential. (auth)

3189

COMPOUND ELASTIC SCATTERING OF NEUTRONS. W. S. Emmerich and R. M. Sinclair (Westinghouse Research Labs., Pittsburgh). Phys. Rev. 104, 1399-1401 (1956) Dec. 1.

The complex potential model predicts a division of the average neutron elastic scattering cross section into shape and compound scattering. The normalized differential elastic cross sections calculated from this model are expanded in a series of Legendre polynomials and compared with data derived from experiments, demonstrating the presence of compound elastic scattering. (auth)

3190

MULTIPLE SCATTERING OF 2.4-MEV ELECTRONS IN NUCLEAR EMULSION. Charles E. Violet (Univ. of California Radiation Lab., Livermore). Phys. Rev. 104, 1454-8 (1956) Dec. 1.

The multiple scattering of 2.39 ± 0.09 Mev electrons in Ilford G-5 emulsion has been measured for cell lengths of 10, 20, and 40 microns. The independent data of three observers were combined to obtain the best value of the mean scattering angles with and without experimental cutoff. The associated scattering factors for cell lengths between 10 and 40 microns are: $K_{c\theta} = 24.9 \pm 1.2$ Mev degrees/(100 microns)$^{0.59}$ (for a cutoff at 4 times the mean deviation) and $K_{\theta} = 25.1 \pm 0.8$ Mev degrees/(100 microns)$^{0.58}$. The corresponding values from the Molière theory are 23.5 and 25.7, respectively. (auth)

3191

SEPARATION OF THE CROSS SECTION FOR SCATTERING OF PHOTONS BY PROTONS INTO SPIN-FLIP AND NON-SPIN-FLIP PARTS. R. Gomez and D. Walecka

(Massachusetts Inst. of Technology, Cambridge). Phys. Rev. 104, 1479-81(1956) Dec. 1.

The spin-flip and non-spin-flip scattering amplitudes of the differential cross section for Compton scattering by protons are presented, and the corresponding cross sections are also given. (auth)

3192

APPROXIMATION METHOD FOR SHORT WAVELENGTH OR HIGH-ENERGY SCATTERING. L. I. Schiff (Stanford Univ., Stanford, California). Phys. Rev. 104, 1481-5(1956) Dec. 1.

The approximation method developed in a recent paper is extended to the scattering theory of Maxwell's equations and of the Schrödinger equation with spin-orbit interaction. Both of these situations are more complicated than the Schrödinger and Dirac cases considered earlier. However, while the electromagnetic case yields the earlier type of result in which the Born formula is modified by the inclusion of an additional phase factor, the Schrödinger spin-orbit case cannot be put in such a simple form. Brief mention is also made of the tensor interaction, which is even more complicated than the spin-orbit interaction, and of the space-exchange interaction, which can be treated by this method only if the potential is symmetric with respect to inversion. (auth)

3193

EMISSION OF ELECTROMAGNETIC RADIATION BY THE IMPACT OF POSITIVE IONS OF HYDROGEN ON METAL SURFACES. Rafi M. Chaudhri, Mustafa Yar Khan and Abdul Latif Taseer (Government College, Lahore, West Pakistan). Phys. Rev. 104, 1492-3(1956) Dec. 1.

A well-defined beam of ions was obtained from a discharge tube, and particles of a definite energy range were selected by an electrostatic analyzer. The electromagnetic radiation emitted by the impact of positive ions on Ni was detected by photomultiplier tubes. Most of the radiation detected lies between 3300 and 4000 A, though there are lines between 4700 and 4900 A. (B.J.H.)

3194

ABSOLUTE CROSS SECTION FOR ELECTRON SCATTERING FROM PROTONS. Robert W. McAllister (Stanford Univ., Stanford, California). Phys. Rev. 104, 1494(1956) Dec. 1.

Electrons at 189.6 Mev were scattered through 60° in the laboratory frame from polyethylene and C targets. The results yielded an absolute cross section for scattering from protons under these conditions. (B.J.H.)

3195

ELASTIC SCATTERING OF DEUTERONS BY O^{16}. D. W. Berger and O. J. Loper (Massachusetts Inst. of Technology, Cambridge). Phys. Rev. 104, 1603-6(1956) Dec. 15.

Thin targets of silicon dioxide on Formvar were bombarded with deuterons in order to study the yield of deuterons elastically scattered from O^{16}. The incident deuteron energy was varied in approximately 20-kev steps from 4.6 to 7.2 Mev for observations at 130 degrees, and from 4.6 to 7.0 Mev for observations at 90 degrees. The absolute cross section was determined by comparisons with the known O^{16} elastic proton cross section. The yield shows resonant structure; in particular, at least eight maxima occur at 130 degrees, and five of these appear at 90 degrees. The resonances are not isolated but indicate overlapping levels. (auth)

3196

ZERO-ENERGY SCATTERING OF NEUTRONS BY OPTICAL MODELS. Harvey Amster (Westinghouse Electric Corp., Bettis Plant, Pittsburgh). Phys. Rev. 104, 1606-11(1956) Dec. 15.

If the imaginary part of the complex square-well potential is adjusted to produce the correct-sized giant resonances in the total cross sections of light nuclei, it is found to be too large to do the same for heavy nuclei and too small throughout most of the range of mass numbers to produce a suitable zero-energy strength function. Damping of giant resonances from optical potentials can generally be correlated with that of a zero-energy scattering amplitude, and the square well defects mentioned can all be studied with analytic simplicity at zero energy. When total cross-section data matching is performed for a square-well or a diffuse-edged potential, the imaginary part will be much less dependent on mass number if it is concentrated into a surface layer. However, once the parameters of any reasonable spherically symmetric potential have been determined from matching total cross sections, a general relationship prohibits complete experimental agreement with the zero energy strength function. For certain potentials, disregarding the data for those nuclei known to be distorted does result in excellent agreement. (auth)

3197

DIRECT INTERACTION IN NEUTRON INELASTIC SCATTERING. John R. Lamarsh (Brookhaven National Lab., Upton, N. Y.) and Herman Feshbach (Massachusetts Inst. of Technology, Cambridge). Phys. Rev. 104, 1633-9 (1956) Dec. 15.

The direct interaction contribution to the cross section for the inelastic scattering of neutrons leading to the excitation of a single particle of the target neucleus is derived by using the method of distorted waves. The interaction potential between the incident neutron and target nucleon is taken to be a three-dimensional delta function, and the incident and emergent neutrons are assumed to move in the complex potential of the "cloudy crystal ball" model. The wave functions for the target nucleons are described in terms of the single-particle model. The theory is applied to the excitation of the first level in C^{12}. The angular distribution of the emergent neutrons is forward-peaked. The magnitude of the cross section is small, however, and the effect will most easily be observed at neutron energies which lie between the levels of the compound nucleus. (auth)

3198

ALPHA-ALPHA PARTICLE SCATTERING IN THE ENERGY RANGE 12.3 TO 22.9 Mev. R. Nilson, R. O. Kerman, G. R. Briggs, and W. Jentschke (Univ. of Illinois, Urbana). Phys. Rev. 104, 1673-80(1956) Dec. 15.

Absolute differential cross sections for alpha-alpha particle scattering have been measured at ten energies between 12.3 and 22.9 Mev. The laboratory angular range studied is 11° to 50°. The higher energy experiments at 21.65 to 22.9 Mev were concurrently carried out at two separate scattering chambers, one using nuclear emulsions as the detectors, the other, proportional counters. The experimental accuracy of these experiments is two percent or better at most angles. At the lower energies, 12.3 to 20.4 Mev, the study was made with nuclear emulsion detection only and the experimental accuracy is about three percent at most angles. (auth)

3199

π^+-P SCATTERING AT 10–35 MEV IN A DIFFUSION CLOUD CHAMBER. M. H. Alston, W. H. Evans, Maria Fidecaro, R. W. Newport, G. Von Gierke, and P. R. Williams (Nuclear Physics Research Lab., Univ. of Liverpool). Proc. Phys. Soc. (London), A69, 798-803(1956) Nov.

An investigation has been made of $\pi^+ - p$ scattering at incident pion energies of $20(\pm\frac{1}{10})$ Mev, using a hydrogen filled diffusion cloud chamber in a magnetic field. Fifteen $\pi^+ - p$ scattering events were observed and the incident pion spectrum and path length were determined from measurements on $\pi - \mu$ decays. The results were analyzed by using the values for the phase shifts $\alpha_{33} = 0.235\eta^3$, $\alpha_{31} = 0$ and assuming that α_3 is directly proportional to η. The phase

shift α_3 was then found to be $-(0.13 \pm 0.035)\eta$ radians, where η is the pion momentum in mass units. (auth)

3200

ELECTRON CAPTURE AND IONIZATION IN COLLISION OF SINGLE-CHARGED POSITIVE IONS WITH GAS ATOMS. N. V. Fedorenko, V. V. Afrosimov, and D. M. Kaminker. (Leningrad Inst. of Technical-Physics). Zhur. Tekh. Fiz. 26, 1929-40(1956) Sept. (In Russian)

Total cross sections were determined for capture of electrons by fast ions from the atomic shell (σ_θ), for free electrons escaping from atomic and ionic shells (σ_-), and for formation of slow single-charge ions (σ_+). The cross section relations to the ionic energies (T_θ) in the energy range of 3 to 180 kev were investigated for A^+-A, A^+-Kr, Ne^+-A, He^+-He, He^+-Ne, He^+-A, and He^+-Kr. Within the investigated energy range the curve σ_θ (T_θ) reached maximum for A^+-Kr, He^+-Ne, He^+-A, and He^+-Kr; for the He^+-He, and He^+-Kr it slowly diminished, while the total cross sections of free electrons steadily increased. Data are given for the σ_- value in argon ionization by He^+, Ne^+, and A^+, and, also, for the ionization of various gases (He, Ne, A, and Kr) by the same ion (H^+). (R.V.J.)

3201

GAS IONIZATION BY He^+, Ne^+ AND A^+ WITH FORMATION OF MULTICHARGED IONS PRODUCED BY SINGLE COLLISION. N. V. Fedorenko and V. V. Afrosimov (Leningrad Inst. of Technical-Physics). Zhur. Tekh. Fiz. 26, 1941-54 (1956) Sept. (In Russian)

A mass spectrometric study was made of slow ions formed by single collisions of He^+, Ne^+, and A^+ accelerated to 3 to 180 kev with the atoms of He, Ne, A, and Kr. The cross sections of slow ions with various charges were determined for A^+-A, A^+-Kr, Ne^+-A, He^+-He, He^+-Ne, He^+-A, He^+-Kr. Comparison of the data on ionization of argon atoms by He^+ ions and electrons indicated that with the equal cross-section velocities ionizations with formation of multi-charged ions were considerably larger in the ion collisions. (R.V.J.)

3202

ABSORPTION OF BETATRON BREMSSTRAHLUNG EMISSIONS IN A TWO-LAYER ABSORBER. A. N. Orlov and G. V. Fedorov (Ural Akad. of Science). Zhur. Tekh. Fiz. 26, 1991-3(1956) Sept. (In Russian)

Refer also to abstract 3001.

RADIATION EFFECTS

3203 IPI-14

Atomic Energy of Canada Ltd. Chalk River Project, Chalk River, Ont.

THE DEGASSING OF COBALT METAL BEFORE IRRADIATION. G. R. Matteau and R. E. Manson. Feb. 10, 1955. 8p.

The leakage and distortion of cold weld capsules loaded with Co pellets were investigated. The tests indicated that the distortion could be prevented by preheating the Co pellets at 300°C (572°F) in a muffle furnace before loading and sealing in the capsules. Further heating tests have been made using a vacuum oven in an attempt to degas the metal at the lowest possible temperature in order to prevent excessive oxide formation. Parallel tests were conducted in a muffle furnace for comparison. The uptake of gas on cooling the pellets was also studied. The amount of bulging was determined by sealing the treated pellets in a cold weld capsule under one-half atmosphere of He gas in the normal manner and then heating in a muffle furnace at 300°C (572°F) until no further bulging occurred. The sealed capsules were measured with a micrometer caliper before and after heating. (auth)

3204 NAA-SR-1716

Atomics International Div., North American Aviation, Inc., Canoga Park, Calif.

THERMAL AND ELECTRICAL PROPERTIES OF GRAPHITE IRRADIATED AT TEMPERATURES FROM 100 TO 425 K. G. E. Deegan. Dec. 15, 1956. 77p. Contract AT-11-1-GEN-8. $0.45(OTS).

The pertinent results of a graphite cyclotron-irradiation program are summarized. Experimental data are presented for the thermo-electric power, electrical resistivity and thermal conductivity of graphite (the medium-particle-size AWG type) as a function of several proton irradiations made at various temperatures. Also given are data on pulse annealing and temperature dependence of these properties, measured in-place (in the 60-in. cyclotron) or after removing the samples to the laboratory. The irradiation temperature was varied from 103 to 423 K and the proton exposure of 0.65 to 30 $\mu ah/cm^2$. The results of one liquid-nitrogen-temperature neutron irradiation and of several room-temperature Hanford irradiations are included for comparison. It was generally found that irradiating at 300 K produced the same property changes as irradiating at 103 K and then annealing to 300 K. However, the 423 K irradiations were appreciably less effective in producing property changes than the 300 K irradiation plus 423 K annealing, at least for exposures greater than 5 or 10 $\mu ah/cm^2$. In pulse annealing of samples irradiated at 103 K, it was found that recovery of all properties was very marked at about 150 K and higher and when room temperature was attained, some 15 to 50% (depending on the exposure) of the initial property changes was recovered. In pulse annealing to higher temperatures, the well known strong recovery state starting at about 400 K was observed. In comparing the proton-damaged samples with neutron-damaged ones, it was found that a correlation (of approximately 1 $\mu ah/cm^2 = 1.5$ Mwd/ct) could be found for the thermal and electrical resistivities, but not for the thermoelectric power. The latter effect is not yet understood. The apparatus for the various experimental work is described, but does not discuss interpretation to any appreciable extent. Most of the data is given both in tabular form and graphical. (auth)

3205 WADC-TN-55-639

Wright Air Development Center. Electronic Components Lab., Wright-Patterson AFB, Ohio.

GAMMA IRRADIATION OF GERMANIUM TRANSISTORS. Ralph J. Panos. Dec. 1955. 50p. Project title: ELECTRONIC TUBES AND TRANSISTORS. (AD-80851).

One-hundred Ge transistors were irradiated by a gamma source, Co^{60}, for various periods of time. This was done to determine the effect of controlled amounts of radiation on these transistors. As the exposed radiation time is increased, a corresponding increase is observed in the change of the four parameters under study from the initial values. (auth)

3206 WCRT-TN-54-255

Wright Air Development Center. Materials Lab., Wright-Patterson AFB, Ohio.

GAMMA IRRADIATION OF CRYSTAL DIODES. Robert C. Young. Dec. 1954. 8p. (AD-85788).

In general, there is an increase in back current, when the diodes are placed in gamma radiation, which returns to normal upon removal if the total dose received is low. No change is observed in the forward curve. Above a certain dose (which was much higher for the silicon 1N137 diodes than the germanium 1N83) the diode held up as long as irradiation continued, but deteriorated upon removal. There seems to be a concurrent increase in forward resistance, but this seems to be negligible until after the

decrease in reverse resistance makes the diode unusable. (auth)

RADIOACTIVITY

3207
GAMMA DOSE RATES IN CYLINDRICAL SOURCES. Donald R. Smith and Marvin C. Atkins (Air Force Institute of Tech., Dayton, Ohio and Wright Air Development Center, Dayton, Ohio). Nucleonics 14, No. 12, 25(1956) Dec.

A method for the calculation of γ-ray exposure dose rate at the center of a given cylindrical Co^{60} source is presented. The design of a source for a required flux in a given volume is discussed. (W.L.H.)

3208
THE RADIOACTIVITY OF THOROTRAST. J. Rundo (Finsen Lab., Copenhagen ϕ, Denmark). Phys. in Med. and Biol. 1, 138-46(1956) Oct.

3209
NOTE ON THE 1.75-MEV GAMMA RAY FROM THE DECAY OF ^{56}Co. M. Morita (Kobayasi Inst. of Physical Research, Kokubunzi, Tokyo); H. Ogata (Department of Physics Tokyo Univ. of Education) and M. Sakai (Inst. for Nuclear Study Tokyo Univ., Japan). Physica 22, 915-16(1956) Oct.

3210
PSEUDOSCALAR INTERACTION IN THE DECAY OF ^{144}Pr. M. J. Laubitz (Cavendish Lab., Cambridge). Proc. Phys. Soc. (London), A69, 789-97(1956) Nov.

The ground state beta transition of Pr^{144} has been studied experimentally and the results analyzed. The analysis depends upon the spin assumed for the ground state of P^{144}; if that state has spin and parity 0^-, as strong evidence indicates, then pseudoscalar interaction is needed to explain the results satisfactorily. The ratio of the coupling constants of pseudoscalar to tensor interactions required is approximately 100. (auth)

3211
ABSOLUTE STANDARDIZATION OF BETA-EMITTING ISOTOPES WITH A LIQUID SCINTILLATION COUNTER. J. Steyn (National Physical Lab., Pretoria, South Africa). Proc. Phys. Soc. (London), A69, 865-7(1956) Nov.

RARE EARTHS AND RARE-EARTH COMPOUNDS

3212
RESULTS OF INVESTIGATIONS OF ISOTOPIC SHIFT IN THE SPECTRUM OF NEODYMIUM. F. A. Korolev and Yu. I. Osipov (Lomonosov Moscow State Univ.). Doklady Akad. Nauk S.S.S.R. 110, 365-7(1956) Sept. 21. (In Russian)

The phenomenon of the isotopic shift in the natural mixture of the isotopes in the area of 4450 to 6500 A was investigated. (R.V.J.)

SHIELDING

3213 HW-42555
Hanford Atomic Products Operation, Richland, Wash.
HIGH-DENSITY CONCRETE FOR REACTOR CONSTRUCTION. Harold S. Davis. Apr. 17, 1956. Decl. May 1, 1956. 23p. Contract [W-31-109-Eng-52]. $4.80(ph OTS); $2.70(mf OTS).

The quality and uniformity of the heavy aggregates were very good. The steel, limonite, and magnetite aggregates, and the grout used produced sound concrete having a compressive strength of over 5,000 psi at 60 days. Workmanship and control during construction were adequate for obtaining concrete having the specified density and composition. Reasonable assurance was obtained that the coarse aggregates were prepacked to the required densities; that segregation and breakage of pieces of coarse aggregate were minimized; that all void spaces in the aggregate mass were filled with limonite grout; and that the concrete hardened in full contact with pipe, casings, and other embedded items. The Intrusion-Prepakt method is suitable for constructing concrete shields made with heavy aggregates. Especially is this true when steel punchings are used as coarse aggregate or high-density concrete is to be placed in restricted areas and around numerous embedded items. (auth)

3214
A SERIES FOR THE F-FUNCTIONS OF SHIELDING COMPUTATIONS. F. T. Binford (Operations Div., Oak Ridge National Lab., Tenn.). Nucleonics 14, No. 12, 62-3(1956) Dec.

SPECTROSCOPY

3215
PHOTOELECTRIC EMISSION FROM THE VALENCE BAND OF CESIUM IODIDE. H. R. Philipp and E. A. Taft (General Electric Research Lab., Schenectady, N. Y.). Phys. and Chem. of Solids 1, 159-63(1956) Nov.

Photoelectric emission has been obtained both from evaporated films and from single crystals of CsI. For $h\nu < 6$ ev, the yield is relatively low and varies widely from sample to sample. It is ascribed here to direct ionization and to exciton-induced emission from uncontrolled impurities and imperfections. For $h\nu > 6$ ev, the yield rises abruptly to much higher values in a reproducible way for all samples. This effect is attributed to emission from the upper edge of the valence band lying about 6 ev below the vacuum level. Energy distributions of the photoelectrons are consistent with these views. Concurrent optical absorption measurements show detail consistent with band-to-band transitions if the electron affinity of CsI is judged to be less than 0.3 ev. (auth)

3216
WIDE-ANGLE TWO-DIRECTION FOCUSING BY THE BETA SPECTROMETER. Günter Lehr (Aus dem Physikalischen Institut der Universität Marburg). Sitzber. Ges. Beforder. Ges. Naturw. Marburg 78, 47-82(1955) Jahrgang. (In German)

Refer also to abstract 2852.

URANIUM AND URANIUM COMPOUNDS

3217 ORNL-2009
Oak Ridge National Lab., Tenn.
U L_I X-RAY TRANSITION FROM SEPARATED ISOTOPES. George L. Rogosa and William F. Peed. Sept. 26, 1955. 9p. Contract W-7405-eng-26.

The $L\beta_3(L_I \rightarrow M_{III})$ x-ray transition of U has been measured from separated isotopes using a double crystal x-ray spectrometer. Special target pellets were fabricated and placed inside a demountable and continously pumped x-ray tube. No evidence for an isotope shift on the L_I x-ray level was found in the measurement of this transition from separated isotopes of U^{233}, U^{235}, and U^{238}. (auth)

3218
PARAMAGNETIC RESONANCE ABSORPTION IN $^{235}UCl_3$, AND THE NUCLEAR ELECTRIC QUADRUPOLE MOMENT OF ^{235}U. B. Bleaney, C. A. Hutchison, Jr., P. M. Llewellyn and D. F. D. Pope (Clarendon Lab., Oxford). Proc. Phys. Soc. B69, 1167-9(1956) Nov.

PATENTS

CHEMISTRY

3219

PROCESS FOR PRODUCTION OF URANIUM HEXAFLUORIDE. Homer F. Priest (to U. S. Atomic Energy Commission). U. S. Patent 2,761,756. Sept. 4, 1956.

A method for the production of UF_6 directly from UO_3 without the necessity of first reducing the UO_3 to UO_2 is described. In the process the UO_3 is reacted with either anhydrous HF, or with an aqueous solution of HF. The product of this reaction, UO_2F_2, is then fluorinated directly to UF_6 by reaction with F_2 at an elevated temperature. (auth)

3220

PROCESSES OF RECOVERING URANIUM. M. D. Kamen et al (to U. S. Atomic Energy Commission). U. S. Patent 2,761,757. Sept. 4, 1956.

A process for the recovery of U after its treatment and separation in a calutron is described. The stainless steel collector pocket, upon which the metallic U has been deposited is made the anode in an electrolytic cell with an 0.01N H_2SO_4 electrolyte. The U is thus plated off of the anode, together with traces of Fe, Cr and Ni impurities arising from the stainless steel, and into solution. All of these metal ions are in their lower valent states in this solution. This solution is then made the electrolyte in a second cell, one having a Hg cathode. When the current is passed through this cell, the Fe, Cr and Ni are all reduced to the metal and combine with the Hg cathode. The U, however, is not so reduced but remains in solution as the tetravalent ion, and is thus separated from the impurities arising from the stainless steel. The U is subsequently precipitated as the hydroxide by ammonia and may then be calcined to the oxide. (auth)

3221

PROCESS FOR RECOVERY OF URANIUM. R. S. Long et al (to U. S. Atomic Energy Commission). U. S. Patent 2,761,758. Sept. 4, 1956.

A process for the recovery of U from acidic phosphate solutions containing only a very small amount of U is described. Such solutions are produced in the ordinary course of treating phosphate rock to manufacture phosphate fertilizer, and the U may be extracted economically as a by-product of this treatment. The uranium in the solution is first reduced to the tetravalent state by any appropriate means. Antimony or an Sb salt, preferably the trioxide, is then added and the solution agitated, resulting in the precipitation of an antimony oxyphosphate, which carries the U. After filtration, the U may be recovered from this precipitate by leaching with NH_4OH, Na_2CO_3 or NaOH. (auth)

3222

REMOTE CONTROL MANIPULATOR. R. C. Goertz et al (to U. S. Atomic Energy Commission). U. S. Patent 2,764,301. Sept. 25, 1956.

A master-slave-type remote manipulator suitable for handling radioactive or toxic substances is described. This manipulator has the novel capability of being inserted through a small hole in the barrier by means of a joint that may be extended and linearly aligned with the transverse and slave arms. When inserted, the joint may be distended and connected to provide the necessary leverage for manipulation of the slave arm. This feature permits the use of one manipulator in many positions with maximum safety, where previously either many manipulators were necessary or dangerously large apertures were required in the barrier. (auth)

3223

PURIFICATION OF URANIUM PEROXIDE. Clarence L. Richardson et al (to U. S. Atomic Energy Commission). U. S. Patent 2,764,470. Sept. 25, 1956.

Uranium peroxide, as manufactured, sometimes contains objectionable amounts of fluoride impurities. This fluoride may be removed by agitating the UO_4 with aqueous HNO_3 or H_2SO_4 of controlled concentration, the acid dissolving most of the fluoride and but little of the UO_4. An acid solution having a pH of from 0.1 to 2.0 may be employed, the more concentrated solutions in this range effecting a greater degree of purification and a greater dissolution of the UO_4. Recovery of the small amount of UO_4 dissolved in this manner, may be made by neutralizing the acid leach solution with alkali, thus causing precipitation of the UO_4. This material is, of course, contaminated with fluorides and may be added to the feed for the first, or fluoride removing, step. (auth)

3224

RECOVERY OF URANIUM FROM DILUTE SOLUTIONS BY A PRECIPITATION METHOD. Glenn W. Kinzer (to U. S. Atomic Energy Commission). U. S. Patent 2,764,471. Sept. 25, 1956.

A method is presented for the recovery of U from aqueous solutions in which its concentration is very low, while relatively large amounts of other metals are present. Such solutions occur during the processing of phosphate rock to make superphosphate fertilizer. The U can be selectively precipitated from such solutions by the addition of one of certain aromatic phosphoacids or arsenoacids. A large number of such acids are discussed together with data on their performance in effecting this selective precipitation. Bis-benzenephosphinic acid is noted as a preferred reagent. Subsequently, the uranyl bis-benzenephosphinate precipitate is treated with dilute NaOH to produce water insoluble sodium diuranate and soluble sodium bis-benzenephosphinate, which may then be recovered and reused in the process. (auth)

3225

IMPREGNATED CRUCIBLE. George Meister (to U. S. Atomic Energy Commission). U. S. Patent 2,766,032. Oct. 9, 1956.

A method for producting crucibles which are chemically inert towards molten U is described. Since most refractory crucibles of commerce will react with molten U it is necessary to coat these bodies with a non-reactive material such as ThO_2, ZrO_2 or BeO. This coating is produced by dipping the crucible in a solution of $Th(NO_3)_4$, or $Zr(NO_3)_4$ or $Be(NO_3)_2$ as the case may be, drying the dipped crucible first in the air and then at 100°C and then firing it at 1000°C in order to decompose the deposited $Th(NO_3)_4$ to ThO_2, O_2 and oxides of nitrogen. The O_2 and oxides of nitrogen leave the crucible as gases, but the ThO_2 remains in the interstices and on the surface of the crucible. The entire process is then repeated 3 to 5 times until a coating of the desired depth and thickness is built up. (auth)

3226

METHOD OF REFINING URANIUM. G. Meister (to U. S. Atomic Energy Commission). U. S. Patent 2,766,110. Oct. 9, 1956.

Impure U is added to a fused salt bath wherein the temperature is maintained at about 1200°C. The impurities in the U either volatilize or are converted into products which volatilize or dissolve in the fused salt. A mixture of KHF and $BaCl_2$ is mentioned as the preferred salt bath and the process is advantageously carried out in a flow of inert gas, although this is not necessary. The purified U coalesces and collects in the bottom of the vessel, and may either be tapped while molten or broken out after solidification. (auth)

3227

METHOD FOR DECONTAMINATION OF RADIOACTIVELY CONTAMINATED AQUEOUS SOLUTION. S. Lowe (to U. S. Atomic Energy Commission). U. S. Patent 2,766,204. Oct. 9, 1956.

The decontamination is effected by subjecting the radioactive solution to a series of Fe and Ca salt precipitations, which precipitations remove with them the contaminating particles and ions. After an initial adjustment of the solution to pH 1.0, Na_2S is added to raise the pH to 4.0. Ferrous ion in the form of $FeSO_4$ is added and a precipitate of FeS is formed at pH 4.0. The solution is then adjusted to pH 10 with NaOH. Since the precipitation of FeS is not fully efficient at pH 4.0, some ferrous ion remains in the solution and is precipitated at pH 10 as $Fe(OH)_2$. A $Ca_3(PO_4)_2$ precipitate is then formed by the addition of $CaCl_2$ and an alkali phosphate. The three precipitation operations, FeS, $Fe(OH)_2$ and $Ca_3(PO_4)_2$ have a combined decontamination factor of about 10^3, and the volume of the contaminated material, i.e. the precipitates have a volume half of that obtainable by other processes, thus simplifying storage or burial problems. (auth)

3228

PLUTONIUM RECOVERY PROCESS. O. F. Hill and S. G. Thompson (to U. S. Atomic Energy Commission). U. S. Patent 2,767,044. Oct. 16, 1956.

In order to separate Pu from an aqueous solution of U and fission product salts a cycle of carrier precipitations is employed. First, the Pu is oxidized to the hexavalent state, and carbonate ion is added to the solution to complex the Pu. By addition of an aqueous solution of a La salt, a basic lanthanum carbonate precipitate is formed, which removes much of the Ba, Zr and Nb by carrying but does not affect hexavalent Pu. The filtered solution is then treated with a reducing agent which will reduce Pu but not the uranyl ion. The Pu is then removed from the solution by formation of a bismuth hydroxide carrier precipitate. (auth)

3229

PROCESS OF SEPARATING TANTALUM AND NIOBIUM VALUES FROM EACH OTHER. H. A. Wilhelm (to U. S. Atomic Energy Commission). U. S. Patent 2,767,047. Oct. 16, 1956.

A solvent extraction process for separating Ta and Nb values from a mixture of the two as fluorides in an aqueous mineral acid solution is described. The aqueous solution, which is preferably about 6.5 M in acid, comprised of Hf about 0.4 M and the balance HCl, is treated with an oxygenated immiscible organic liquid such as TBP, mesityl oxide and the like. The Ta values are preferentially transferred to the organic phase leaving the Nb values in the aqueous phase. (auth)

3230

PROCESS FOR RECOVERY OF URANIUM AND THE UPGRADING OF ALKALI-URANIUM FLUORIDE PRECIPITATES. R. H. Bailes et al (to U. S. Atomic Energy Commission). U. S. Patent 2,768,059. Oct. 23, 1956.

A process for recovering U from an acid anion exchange resin eluate containing $NaUO_2^{2+}$, and Cl^- ions is described. Following the addition of HF slightly in excess of the amount required to form UF_4, the eluate is treated with a reducing agent, such as $Na_2S_2O_4$, to reduce the uranyl uranium to the uranous condition and precipitate the same as $NaUF_5$. The $NaUF_5$ after removal may be marked with a dilute HF solution to convert it to UF_4. (auth)

3231

METALLIC BOND AND METHOD. T. J. O'Donnell (to U. S. Atomic Energy Commission). U. S. Patent 2,768,433. Oct. 30, 1956.

A method for bonding metal sleeves to cores is described. The outer member or sleeve is of such dimensions that it will fit loosely over the core when both are cold. After being placed on the core, the sleeve is heated rapidly to a temperature high enough to allow plastic flow of the metal, while being held in a clamp or apparatus which prevents radial expansion of the sleeve. The sleeve is thus deformed inward, i.e., changed in such a way that its inner diameter is less than what it was at the start of the operation. The sleeve is then allowed to cool, and in so doing, shrinks to a tight fit on the core. (auth)

3232

HEAT EXCHANGERS. R. Q. Boyer (to U. S. Atomic Energy Commission). U. S. Patent 2,768,813. Oct. 30, 1956.

A method and apparatus is described which was designed to concentrate a salt in a dilute aqueous solution, specifically wash water containing UCl_4, as may be obtained from a calutron. A rectangular arrangement, with a heat exchanger and a relatively large moisture de-entrainment chamber forming the vertical legs, permits a convective current to be set up. Dilute wash water entering at the bottom rises part way into the vertical heat exchanger. Steam flowing through the heat exchanger shell evaporates a portion of the wash water contained in tubes passing through the heat exchanger. The steam with much entrained moisture passes through an expansion chamber across into the de-entrainment head where the steam passes through a moisture separator where the entrained UCl_4 laden moisture drops into wash water and the steam is carried to a condenser and eventually to the calutron feed tank for recycling. This continuous removal of water builds up the concentration of UCl_4 in the solution remaining in the apparatus which is gradually removed for further processing. (auth)

3233

PROCESS USING CARBONATE PRECIPITATION. H. S. Brown et al (to U. S. Atomic Energy Commission). U. S. Patent 2,768,871. Oct. 30, 1956.

A process for recovering Pu from solutions containing Pu together with U and fission products is described. First a suitable reducing agent is added to the solution to insure that all U is in the tetravalent state. Then the pH of the solution is adjusted to between 2.7 and 3.0 by the addition of solid $NaHCO_3$, whereupon a precipitate consisting of basic $U(CO_3)_2$ forms. This precipitate is filtered out, and the pH of the solution is adjusted to about 6.5 with more bicarbonate. A water solution of a suitable La compound is added at this point, causing a precipitate of $La(CO_3)_3$ to form. This precipitate acts as a carrier for the trivalent Pu and removes it from the solution. After filtration, this precipitate is dissolved in HCl, and the Pu oxidized to the hexavalent state. This solution is adjusted to pH 6.5 and another $La(CO_3)_3$ precipitate forms, carrying with it any fission products which were carried on the first precipitation. The hexavalent Pu remains in the scavenged solution. This cycle may be repeated to bring the Pu to a desired state of purity. (auth)

3234

MANUFACTURE OF URANIUM TETRAFLUORIDE. D. X. Klein et al (to U. S. Atomic Energy Commission). U. S. Patent 2,768,872. Oct. 30, 1956.

An improvement on the process for the production of UF_4 from the vapor phase reaction of UF_6 and HCl is described. It has been found that the solid UF_4 produced by this vapor phase reaction is in the form of very fine particles, yielding a powder with a bulk density of approximately 1.0. This powder is not so dense as is desirable in the metallurgical operations employed to produce metallic U. In the present invention, the size of the UF_4 particles and, therefore, the bulk density of the powdered product, are increased by keeping the UF_4 particles suspended in the vapor reaction

mixture, whereby the particles grow larger. This is accomplished by using an excess of HCl gas, or a quantity of any inert gas, and introducing this gas tangentially into the bottom of the inverted conical reaction chamber at high velocity, so as to create a turbulent zone in which the UF_4 particles are suspended. When the particles have grown to a size which will not remain suspended, they have a size 3 or 4 times that of particles produced by the older method, and yield a product with a bulk density of about 2.0. (auth)

3235

METHOD OF PURIFYING URANIUM. N. C. Beese. (to U. S. Atomic Energy Commission). U. S. Patent 2,768,873. Oct. 30, 1956.

A method for purifying U of B impurities is described. Uranium metal powder, contaminated with small quantities of B is first burned to uranium oxide at a temperature of from 400°C to 800°C. The oxide powder is then heated to 1200°C or higher in order to volatilize the B impurities. After removal from the furnace, the uranium oxide has a B content of less than 0.5 ppm. The oxide may then be processed in the usual manner to obtain the metal. (auth)

3236

METHOD OF MAKING A PRODUCT CONTAINING URANIUM 237. A. F. Reid (to U. S. Atomic Energy Commission). U. S. Patent 2,769,776. Nov. 6, 1956.

A sample of UF_6 is bombarded by fast neutrons thus forming a small quantity of U^{237} from the U^{238} present. In the process, a very small portion of the UF_6 is found to undergo a molecular transformation into UF_4 and fluorine gas. This UF_4 is, of course, easily separable from the UF_6. It has been discovered that the U^{237} is contained in the UF_4 fraction of the product in greater amounts and higher percentages than occur in the UF_6. Specifically 50% of the U^{237} produced is concentrated in this UF_4 product, and the percentage amount of U^{237} present is increased a thousandfold over that obtainable by other methods. (auth)

3237

PRECIPITATION PROCESS. W. E. Clifford et al (to U. S. Atomic Energy Commission). U. S. Patent 2,769,780. Nov. 6, 1956.

A method for removing Cs and Sr from aqueous solutions is given. The method is simple, and merely requires formation of a precipitate of $Ni_2Fe(CN)_6$ or $Co_2Fe(CN)_6$ in the solution by the addition thereto of an alkali ferrocyanide and a water soluble salt of Ni or Co. The precipitate acts as a carrier and removes the Cs and Sr. A set of two precipitation operations, one at pH 8-10 and room temperature to remove Cs and the second at a pH over 10 and elevated temperature to remove Sr is found by the inventors to be the most effective embodiment of this process. (auth)

3238

RECOVERY OF URANIUM FROM PHOSPHORIC ACID AND PHOSPHATE SOLUTIONS BY ION EXCHANGE. R. S. Long et al (to U. S. Atomic Energy Commission). U. S. Patent 2,770,520. Nov. 13, 1956.

Uranium in the hexavalent state will form anionic complexes with various ions, notably Po_4^{3-} and Cl^-. This property is made use of in recovering U from solutions wherein the concentration of U is very low. First, an oxidizing agent is added to the solution to convert all of the U present to the hexavalent state. Then the complexing ion, phosphate or chloride, is added to the solution, if not already present. The U complex anion is then adsorbed on an anion exchange resin, from which it may be selectively eluted by any one of a number of elutriants including dilute mineral acids and sulfate or chloride salt solutions. (auth)

3239

SEPARATION OF URANIUM FROM MIXTURES. L. Spiegler (to U. S. Atomic Energy Commission). U. S. Patent 2,770,521. Nov. 13, 1956.

A process for recovering U as a crystalline peroxide from an aqueous solution containing hexavalent U, Mg salts, from H_2SO_4, and small amounts of Ca, F_2 and Fe salts is described. The process comprises heating the solution to a temperature between 70° and 100°C, adjusting the pH to between 3 and 4 and removing precipitated iron hydroxide along with any other solid. The clarified solution is cooled to a temperature between 20° and 45°C to cause precipitation of calcium sulfate which is mechanically removed. The filtrate is treated into sufficient hydrogen peroxide to convert the uranium present to uranium peroxide, along with addition of an alkaline reagent in sufficient amount to keep the pH in the range of 2.5 to 3.5. The solution is maintained at a temperature between 30° and 65°C until uranium peroxide crystallizes out. (auth)

3240

METHOD OF PURIFYING AND RECOVERING VANADIUM FROM PHOSPHATE CONTAINING SOLUTIONS. R. H. Bailes et al (to U. S. Atomic Energy Commission). U. S. Patent 2,770,522. Nov. 13, 1956.

An ion exchange process for the recovery of phosphate free V from phosphatic solutions is described. The V bearing phosphatic solution is passed through a column of cation exchange resin whereby most of the vanadium and only a small amount of the phosphate are adsorbed on the resin. Following washing of the column with water to remove the bulk of the phosphate, the vanadium is eluted with an aqueous solution containing HC and NaCl yielding a vanadyl solution only slightly contaminated with phosphate. This residual phosphate is removed by selective precipitation with titanyl or zirconyl salts and the purified vanadium recovered from the solution by precipitation procedures yielding a hydrous vanadium oxide. (auth)

3241

REMOTE CONTROL MANIPULATOR. D. G. Jelatis (to U. S. Atomic Energy Commission). U. S. Patent 2,771,199. Nov. 20, 1956.

A simplified construction is described of a remote control manipulator in that a counterweight for the slave arm is located adjacent to the master arm in such a way that when the arm is pivotally adjusted independently of the master arm the counterweight is also adjusted. In addition, the slave arm is adjusted with respect to the master arm by electric power rather than manually and the stationary part of the master arm is arranged so that only a small portion thereof extends over the horizontal support, thus reducing the required head room. (auth)

3242

MANUFACTURE OF URANIUM PEROXIDE. Louis Spiegler (to U. S. Atomic Energy Commission). U. S. Patent 2,771,338. Nov. 20, 1956.

An improved method for the production of relatively pure UO_4 from aqueous UO_2SO_4 solutions containing Mg^{2+} and F^-, comprising adding $(NH_4)_2SO_4$ sufficient to establish a ratio of about $2\frac{1}{2}$ mols thereof for each mol of UO_2SO_4, adjusting the temperature to between 30° and 65°C, and maintaining a pH of between 2 to 4 while adding H_2O_2 in sufficient excess to precipitate substantially all the U as UO_4 which is promptly removed by filtration. (auth)

3243

PROCESSES FOR THE RECOVERY AND PURIFICATION OF URANIUM. R. Q. Boyer (to U. S. Atomic Energy Commission). U. S. Patent 2,771,339. Nov. 20, 1956.

A method for the recovery of U from calutron isotope separator wash solutions containing Fe, Cr, Ni, and sometimes, Cu as impurities is described. This method consists in oxidizing the solution and treating it with NH_3 or NH_4OH causing precipitation of $(NH_4)_2U_2O_7$, $Fe(OH)_3$, and $Cr(OH)_3$, the Ni and Cu remaining in solution as complexed ions. The separation of the U values from this composite

precipitate is then effected by dissolving the precipitate in HCl, reducing the U and Fe present with ammonium hyposulfite, adding formaldehyde to complex the excess sulfite and finally adjusting the pH to about 4.4 with NH_4OH, causing the precipitation of uranous hydroxide, which is filtered, washed, and calcined to UO_2. (auth)

3244

IMPROVED URANIUM RECOVERY AND PURIFICATION PROCESSES. M. D. Kamen et al (to U. S. Atomic Energy Commission). U. S. Patent 2,771,340. Nov. 20, 1956.

A method for the recovery of U from a calutron receiver of stainless steel or the like is described. The receiver is washed with an aqueous solution approximately 2% in HCl and 0.5% in H_2O_2 thereby obtaining a solution containing hexavalent U along with various other cation such as Fe, Cr, Ni and Cu. After adjusting the acidity of the solution to a range of 1N to 3N it is treated with a reducing agent to preferentially reduce the U to the uranous state. The solution is then treated with oxalic acid to cause precipitation of uranous oxalate, while the soluble oxalates of the other ions present remain in solution. The uranous oxalate removed by filtration is then calcined to UO_2, which may be further processed as desired. The oxalate filtrate solution may be subjected to a further scavenging step in which a soluble Ca salt is added and the H^+ ion concentration is maintained between 1N and 3N. This causes formation of a calcium oxalate precipitate which carries with it the uranium oxalate produced and any small amount of uranous ions not precipitated as the oxalate. (auth)

3245

PROCESSES OF RECLAIMING URANIUM FROM SOLUTIONS. R. Cummings (to U. S. Atomic Energy Commission). U. S. Patent 2,772,142. Nov. 27, 1956.

A method for the recovery of U from calutron isotope separator wash solutions containing Fe, Cu, and C as impurities. This method consists in reducing the material in the wash solution by agitating it with scrap Fe, whereby the Fe and U in solution are obtained in their lower valence states. There will also be found suspended in the solution small quantities of unionized Fe, Cu, and C. The pH of the solution is adjusted to 4.4 with NH_3 causing a precipitate of uranous hydroxide to form. The solution is filtered and the filtrate containing the ferrous ion is discarded. The hydroxide precipitate containing the unionized Fe, Cu, C and U is slurried and subjected to a froth flotation treatment, whereby the metallic Fe, Cu, C and U are taken up in the froth, separated from the hydroxide and discarded. The uranium hydroxide is filtered from the slurry and calcined to the dioxide. (auth)

ENGINEERING

3246

FILTERING APPARATUS. R. Q. Boyer (to U. S. Atomic Energy Commission). U. S. Patent 2,771,999. Nov. 27, 1956.

A filter that is capable of removing substantially all of a precipitate from a slurry, as well as washing and drying the material is described. The apparatus is capable of receiving a constant feed providing a number of tanks into which the filter element with an attached conduit may be placed, each tank performing at least one of the desired operations on the filtrate. (auth)

Refer also to abstract 3255.

MINERALOGY, METALLURGY, AND CERAMICS

3247

WETTING OF HEAT TRANSFER SURFACES WITH LIQUEFIED METAL HEAT TRANSFER MEDIA. O. C. Shepard et al (to U. S. Atomic Energy Commission). U. S. Patent 2,763,570. Sept. 18, 1956.

A method is described for preconditioning certain refractory metals, e.g. stainless steel, W, Mo, Zr and others, so that molten Pb or Bi, or alloys of the two, will wet the surface of the metal. The method consists in first thoroughly cleaning the metal surface, subjecting it to high vacuum and heating the metal to a high temperature which must at least be higher than the melting point of Pb or Bi. The metal surface while under vacuum and at the elevated temperature is then contacted with the molten Pb or Bi, and it will be found that the metal surface is wetted by the molten Pb or Bi. This wetting of metal surfaces vastly enhances the value and efficiency of heat transfer systems utilizing molten Pb or Bi as a heat transfer agent. (auth)

3248

METHOD OF PREVENTING CORROSION OF IRON METALS. C. R. Breden (to U. S. Atomic Energy Commission). U. S. Patent 2,763,611. Sept. 18, 1956.

A method for reducing the corrosion of Fe and Fe-based alloys, including steel, when these metals are subjected to the action of hot, superpressured water is given. The method consists in adding 50 to 400 cc of H_2 gas/l of H_2O to the H_2O before contacting the Fe metal with it. (auth)

3249

CRUCIBLE AND STOPPER THEREFOR. A. W. Becker et al (to U. S. Atomic Energy Commission). U. S. Patent 2,770,856. Nov. 20, 1956.

A liquid tight plug and a casting crucible that is easily removable and does not drop into the crucible is described. The plug in the bottom of the crucible has a small portion or tip extending below the crucible into a sliding holder. The plug has a bore hole extending into but not through this tip. By sliding the holder sideways, the tip is sheared from the plug but is still retained by the holder. By sliding the holder further, a hole through the holder is aligned with the hole in the plug so that the contents of the crucible may flow down through the bore hole of the plug and the aligned hole of the holder, thus accomplishing the desired objectives. (auth)

3250

METHOD OF MELTING METAL POWDER IN VACUO. D. Wroughton (to U. S. Atomic Energy Commission). U. S. Patent 2,771,357. Nov. 20, 1956.

An improvement in the refining of U is offered which consists in compressing the impure powder into a button, and induction melting the button in a vacuum so that the impurities present tend to accumulate as a floating slag on the surface of the molten U, thus effecting a degree of concentration of these impurities. After solidification, this U slug may then be refined by induction melting it while on a strainer placed in a crucible with a hole in its bottom. The U melts and flows through the strainer leaving the impurities entrapped on the strainer. (auth)

PHYSICS

3251

POSITIVE ION ELECTROSTATIC ACCELERATOR. C. M. Turner (to U. S. Atomic Energy Commission). U. S. Patent 2,762,941. Sept. 11, 1956.

A method and apparatus for improving the performance characteristics of electrostatic generators is described. When attempting to raise the maximum attainable voltage of such a generator a phenomena called electron loading occurs which results from electrons flowing back from the low voltage end of the accelerator tube and generating x-rays at the high voltage end which cause ionization in the high pressure insultating gas resulting in a leakage of the electric potential being accumulated. In the subject appa-

ratus a plate of high electron absorption capabilities, e.g. Be, is mounted to intercept the back flow of electrons, and since this plate may still emit weak x-rays, a radiation absorbing shield of Pb or material with similar qualities is located between the electron absorbing plate and the insulating gas, thus eliminating the ionizing effect and permitting a higher level of operation. (auth)

3252

SPARK GAP. W. R. Baker (to U. S. Atomic Energy Commission). U. S. Patent 2,763,816. Sept. 18, 1956.

A relay design is given which may be triggered by an overload condition in a radio-frequency line to isolate valuable equipment on the line that could be damaged by the overload condition. Two concentric electrodes are connected in unidirectional circuit, the inner electrode of which is connected through a capacitor to ground. Slightly removed from these electrodes is a third button electrode connected to the transmission line. When the overload voltage occurs a spark jumps from the button electrode to the inner electrode and hence to ground. This spark sufficiently ionizes the atmosphere that a spark may jump between the concentric electrode thereby completing the unidirectional circuit and activating cutoff controls for the equipment to be protected, thus, in the minimum amount of time, protecting the equipment. (auth)

3253

PULSED OSCILLATOR. W. C. Struven (to U. S. Atomic Energy Commission). U. S. Patent 2,764,689. Sept. 25, 1956.

A pulse oscillator that delivers a constant frequency a-c output whenever there is a triggering voltage at the controlling terminal is described. The oscillator circuit comprises a pentagrid vacuum tube having its first and second grids tied into a crystal oscillator circuit so that there is a continual oscillating frequency between these two grids. A load resistor is used between the cathode and the first grid for grid bias, and there is a variable capacitor between the cathode and the second grid so that there is a continual oscillating current discharge between the cathode and the second grid. The third grid is connected to the control terminal so that a negative voltage will isolate the signal from the plate, but a positive voltage will result in a high frequency oscillating current output. (auth)

3254

ION SOURCE. R. B. Crawford et al (to U. S. Atomic Energy Commission). U. S. Patent 2,764,707. Sept. 25, 1956.

An ion source is described that will produce a high density accelerated ion beam containing a high percentage of monatomic ions, and in which the duration of pulse and magnitude of the ion beam can be controlled and where there is no associated gas production between pulses. This is accomplished by impressing a current across annuli of Ti, separated by annuli of insulating material in such a manner that sparking will occur down the center of the annuli, thereby causing the ejection of an electron ion beam. (auth)

3255

LEAK DETECTION APPARATUS. W. H. Meyer, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 2,766,442. Oct. 9, 1956.

A heat exchanger design and apparatus that will permit prompt detection of a leak in the exchanger is described. A double tube sheet is provided that creates a void between the primary tube sheet header and the shell containing the secondary fluid, the tubes passing through both tube sheets. This design creates a double barrier through which any leaking fluid must pass. A conduit leads from this void to a chamber containing an electrode electrically isolated from the chamber body which is grounded. Any liquid leaking through the tube to tube sheet seal welds will flow through the conduit to this chamber and complete an electrical circuit activating some suitable alarm device or control, thereby preventing extensive damage that may occur from undetected fluid leakage. (auth)

3256

TESTING MATERIAL IN A NEUTRONIC REACTOR. E. Fermi et al (to U. S. Atomic Energy Commission). U. S. Patent 2,768,134. Oct. 23, 1956.

A means of testing the nuclear properties of materials to be used in a nuclear reactor is given. This is accomplished by placing in an operating reactor the materials loaded on a transverse stringer or tray type device of sufficient length that upon withdrawing the portion containing the materials tested a portion containing the customary reactor components is drawn into place, thereby completing the reactor core integrity. A cadmium control rod suitably indexed is used to maintain constant flux density in the reactor, thus, by comparing the two readings of the control rod positions, a relationship may be established between the nuclear properties of the tested material and the normal reactor components. Such information is an important aid in atomic research. (auth)

3257

TIME-OF-FLIGHT NEUTRON SPECTROMETER. W. I. Linlor et al (to U. S. Atomic Energy Commission). U. S. Patent 2,769,094. Oct. 30, 1956.

An apparatus that measures the energy level of neutrons produced from various materials is described. The material is bombared by charged particles from a cyclotron. The time of flight of the released neutrons is electronically measured by comparing a signal generated when the neutron is released with the signal generated by the neutron impinging on a detector some distance from the point of release. The different signals are measured by a coincidence circuit that causes visual signal on an oscillograph that may be photographed. (auth)

3258

PULSE FORMING NETWORK. G. D. Paxson (to U. S. Atomic Energy Commission). U. S. Patent 2,769,903. Nov. 6, 1956.

A radio frequency synchronizer for synchronizing a low repetition rate triggering pulse with a predetermined point on a sinusoidal voltage signal is described. It was developed for use in a cyclotron for synchronizing the deflector trigger voltage with the accelerating voltage signal. The circuit consists of a first and a second stage multi-element tube with the sinusoidal voltage signal being applied to the first stage control electrode, the triggering voltage to the first stage screen electrode, and the first stage anode to the second stage screen electrode. An adjustable phasing means is connected between the second stage anode and the output pulse source, resulting in the latter being synchronized with the sinusoidal wave voltage. (auth)

3259

ELECTRONIC PRESSURE DIFFERENTIAL WIND DIRECTION INDICATOR. H. Moses (to U. S. Atomic Commission). U. S. Patent 2,770,128. Nov. 13, 1956.

A sensitive wind direction sensing and recording apparatus providing rapid, inertia free responses in both azimuth and elevation is described. This is accomplished by introducing wind impact pressure into both sides of a chamber separated by a membrane that immediately detects any unbalance of the pressures and translates them into electric signals by an electro-mechanical transducer. These signals actuate servomotors to reposition the wind impact sources in order to establish a balanced pressure in the sensing chamber. By placing two of these chambers at right angles three directional responses are received. The position of the wind impact sources may be detected and recorded by conventional means. Thus a rapid wind direc-

tion indicator is provided that does not depend upon wind power for positioning the sensing elements. (auth)

3260

REACTOR CIRCULATING SYSTEM. J. T. Serduke (to U. S. Atomic Energy Commission). U. S. Patent 2,770,590. Nov. 13, 1956.

A liquid cooling system for a fast reactor designed to eliminate potential leak sources is described. A suitable liquid such as Hg is forced through the reactor under pressure of a gas, such as He, which is inert to neutrons. The liquid cools the reactor, gives up its accumulated heat to a heat exchanger, and is collected in a low pressure tank. The liquid is transferred from the low to a high pressure tank by electromagnetic pumps, the output of which is regulated by a float in the high pressure tank. Helium under high pressure is maintained in the high pressure tank to cushion the pumping effect of the electromagnetic pumps and to cause and control the circulation of the mercury. This system reduces radiation hazards due to leaks of dangerous coolants by eliminating accessories with gaskets and seals such as mechanical pumps and valves while providing positive circulation and control. (auth)

3261

HEAVY WATER MODERATED NEUTRONIC REACTOR. E. P. Wigner et al (to U. S. Atomic Energy Commission). U. S. Patent 2,770,591. Nov. 13, 1956.

The design of the basic light water cooled, heavy water moderated natural uranium reactor designed to operate at high power levels for an extended period of time to produce plutonium is presented. The uranium, in sealed containers is positioned in aluminum tubes, through which light water flows to maintain a temperature below the melting point of the various materials. Heavy water surrounds the tubes in the reactor core to slow the neutrons, produced by fission, to the energy level necessary for maintenance of the chain reaction and the conversion of uranium 238 by neutron capture to plutonium. Heavy water is found to be a superior moderator to graphite in requiring less volume and capturing less neutrons. This reactor is designed to operate at a power output of 50,000 kilowatts. (auth)

3262

LIMITED AMPLIFIER. R. E. Thomas (to U. S. Atomic Energy Commission). U. S. Patent 2,770,684. Nov. 13, 1956.

An amplifier circuit designed to prevent a very large signal, impressed upon the amplifier, from overcharging the interstage coupling capacitors, thereby rendering the amplifier inoperative is described. The plate resistor of the first tube is limited so that the maximum voltage change is less than the change in the cathode voltage of the second tube so that substantially no grid current flows in the second tube and the coupling capacitor remains uncharged. The usefulness of the amplifier circuit is thereby increased for low level amplification. (auth)

3263

LINEAR ACCELERATOR. M. L. Good (to U. S. Atomic Energy Commission). U. S. Patent 2,770,755. Nov. 13, 1956.

A linear accelerator that permits radial focusing of the ions while maintaining phase stability is described. This is accomplished by having drift tubes which are alternately shortened and lengthened over the relative sizes they would have in a standard machine. The improvement provides a simple, inexpensive way of applying strong focusing techniques to existing accelerators. (auth)

3264

AUTOMATIC BEAM STABILIZATION. R. J. Klein (to U. S. Atomic Energy Commission). U. S. Patent 2,770,756. Nov. 13, 1956.

An improved memory system for a computer utilizing cathode ray tube storage of binary information is described. The signal is stored in a predetermined position on the tube screen and, periodically, the cathode beam is directed to that position to sample the stored information, means for detecting and amplifying the signal, produced by the incidence of the beam on the area where the information is stored, is provided along with a circuit designed to regulate the beam current magnitude with respect to the signal produced so as to keep the signal magnitude substantially constant thus resulting in improved operation of this type of an information storage system. (auth)

3265

PHASE METER. C. N. Winningstad et al (to U. S. Atomic Energy Commission). U. S. Patent 2,771,582. Nov. 20, 1956.

A phase meter that may be applicable to either amplitude modulated or frequency modulated phase measurements is described. Heretofore, the phase meters required the ratio frequency source to be a continuous wave and with a stable frequency. This phase meter measures the phase difference of amplitude modulated ratio frequencies, continous wave or pulsed, when the frequency of the source is not stable. This is accomplished by having a frequency determining tank circuit and developing a voltage at a frequency equal to the difference between the input voltage and that of the tank circuit which may be measured by suitable means to indicate the desired result. (auth)